Enciclopedia en Español de Maquinaria para Minas, Pagina 60

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Engineering and Mining Journal

With which is consolidated Mining and Engineering World

Volume 103, No. 21
Issued Every Saturday
McGraw-Hill Publishing Co., Inc.

NEW YORK, MAY 26, 1917

Price, 15 Cents
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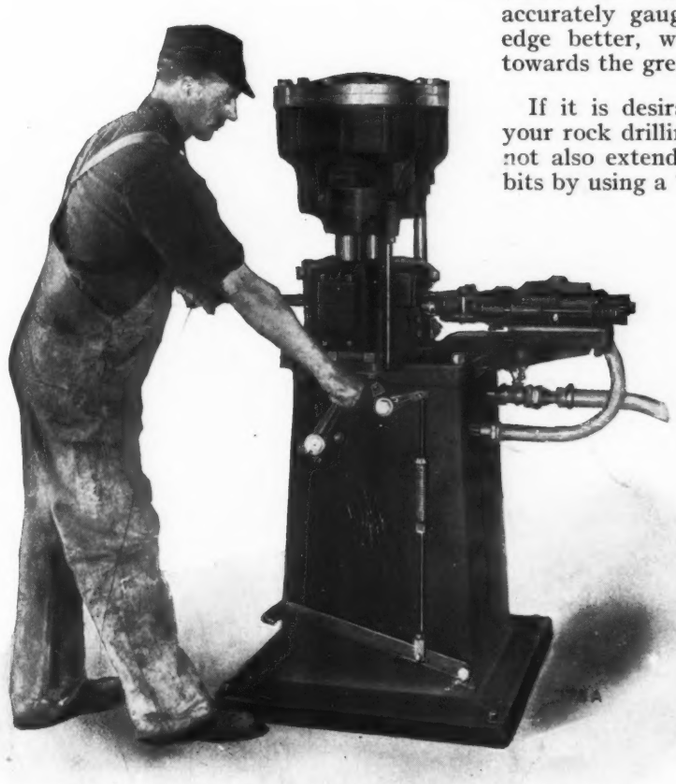

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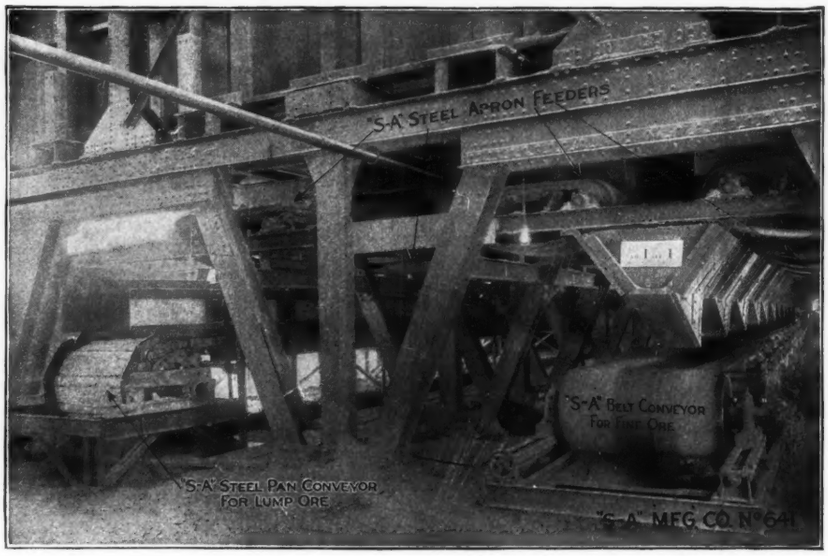

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Engineering and Mining Journal

VOLUME 103 MAY 26, 1917 NUMBER 21

Deep Creek, Clifton Mining District, Utah

By A. E. Custer*

SYNOPSIS—The Clifton Mining District, Utah, known more commonly as the Deep Creek district is prospering, due to the advent of a railroad. Highly mineralized section is being developed after many years of waiting for transportation facilities. Geological and operating data of the territory contiguous to the railway and in line with any future extention, are given.

The district known as "Deep Creek"—the white man's translation of Ibapah—is coming into its own as a metal-producing section of Utah, through the advent of a railroad, and high-grade ore is being shipped daily to the smelteries. The advent of a railroad into the district is due to the untiring energy and strenuous efforts of Duncan MacVichie, who for over 25 years has been one of Deep Creek's strongest advocates and champions, Owing to its isolated situation the district lay dormant until the present year and very little development was made in the properties; in almost every instance just enough work was done to patent the ground. Now that the railroad affords an outlet for the ores, great activity is visible on every hand. The town of Goodwin (Gold Hill) has grown from five houses to over 150, has several stores and supports three lumber yards.

The Deep Creek R.R. connects with the main trunk line of the Western Pacific at Wendover, Utah, and is about 46 miles in length, standard-gage, and well constructed; the terminal of the road is Gold Hill, a point where gold was discovered in the early days. This discovery made quite a stir, and a mill was erected which, later, owing to litigation, was closed. A small smeltery was also built, which turned out several carloads of rich silver-lead bullion. These monuments of past activity are still standing. Tributary to Gold Hill, are the Ferber, Dugway, Fish Springs and other sections in which ore has been discovered. The mineralized zone is a large one, and ores in paying quantities are found for miles. It is probable that extensions of the railroad will be built to take in the camps mentioned.

The district is known as the Clifton Mining District, which includes Clifton and Dutch mountains; it has a highly mineralized surface area about 15 miles long by 8 miles in width. The first mineral discoveries were made in the early 60's, and in 1869 the Clifton Mining District was created. In 1872 a lead smeltery was built and treated several thousand tons of ore. Owing to the demonetization of silver in 1873, and high operating costs due to the fact that the nearest market for supplies was Salt Lake City, about 130 miles distant, the smeltery closed down. Arrangements are now under way to ship the old slag dump. In 1892 an amalgamation mill was built, to treat gold ore from the Cain Springs and Alvarado properties, both of which belong to the Woodman estate. During the last 30 years considerable ore has been shipped to the Salt Lake smelteries, but the long wagon haul made this almost prohibitively expensive, even on high-grade ore. During the last 15 years, several attempts were made to build a railroad into the district, and numerous engineers examined the district for tonnage, development, etc., and without exception found the ore tonnage large enough to justify a railroad, but for some reason or other the promoters failed to build the road. The district is a large one, there being about 300 patented claims and possibly held by compliance with annual assessment requirements.

THE POLE STAR CO.'S SHIPMENT OF THE FIRST ORE SHIPPED OVER THE NEW RAILWAY

Rising gradually from the foothills, about 4000 ft. in elevation, to the highest point, Dutch Mountain with an

*Mining engineer, 31 Post Office Place, Salt Lake City, Utah.

elevation of about 8000 ft., the district is readily accessible. Nearly all the mines can be reached by automobile, and good wagon roads are constructed to the principal mines. Timber is scarce in the district proper, but considerable pine exists 20 miles to the south. Water sufficient for culinary purposes is furnished by a few springs. This is not sufficient for milling, although a large supply could be had from Deep Creek River by piping about 12 miles, or from Redding Spring about 14 miles distant.

The predominating country rocks exposed are granitic porphyries and limestone. The greater part of the area from Gold Hill to the Clifton basin is covered with a dark crystalline rock, composed principally of feldspar, biotite and a little quartz, with plagioclase feldspar predominating. There is also a lighter-colored rock which is very likely granodiorite or monzonite. In places these formations are capped with shale, quartzite and limestone. Gold Hill, upon close inspection, is found to be a highly silicified limestone; a marmarized limestone is found on the southeast slope, while to the north are upended shale beds. The marmarized limestone to the south in turn is covered with the dark crystalline rock of granitic texture. From this exposure of the lime capped with the granitic rock and another exposure about two miles south, one is led to believe that the granitic rocks form a capping to extensive beds of lime.

The district is traversed by fissures which strike in all directions, and cutting all formations is a series of dikes, chiefly of andesite and rhyolite; the stronger fissuring has a north-and-south strike, with much east-and-west fissuring also. Apparently all fissures and dikes are mineral-bearing. Many have shallow prospect holes with some ore showing on the dumps. The surface indications are exceptionally good throughout the entire district. The ore deposits not only make in the fissures, but also along the limestone and porphyry contacts.

Dutch Mountain and the western part of the district are composed mostly of massive sedimentaries, quartzite and limestone; the ridge of Dutch Mountain forms an anticline and shows great faulting.

In the Clift basin the formations are principally limestone, quartz, granite, with some intrusive dikes of rhyolite.

Western Utah Copper Co.

The holdings of the Western Utah Copper Co. consist of five groups of claims, as follows: The Gold Hill group, lying near the north end of the Deep Creek Mountains and comprising nine claims and fractions, or a total of 106.5 acres; the Ochre Springs group, consisting of one patented claim and one claim held by possessory right, lying 2½ miles southwest of the Gold Hill and valuable largely for the water that has been developed by short tunnels and shallow pits; the Toulomne group, consisting of three full claims on Dutch Mountain, situated approximately five miles northeasterly from the Gold Hill group, and totaling 61.98 acres; the Calaveras group, consisting of two full claims and two fractions, comprising 77.91 acres, 2½ miles southwesterly from Gold Hill; and the Yellow Hammer group, consisting of three claims, or a total of 53.93 acres, approximately four miles southwesterly from the Gold Hill group. The entire holdings of the company are patented with the exception of the Olympia, in the Ochre Springs group. The greatest amount of development work has been done on the Gold Hill group and consists of tunnels, crosscuts, winzes and raises and one shaft sunk to a depth of 275 ft. near the portal of the 300-ft. or lower tunnel level. These workings have developed 100,000 tons of ore containing copper, gold and silver that may be considered blocked out and 25,000 tons of probable ore. This ore averages 5.05% Cu, 5.58 oz. Ag, and 0.025 oz. Au and about 5% excess iron. The ore is oxidized, which makes it desirable for smelting.

In addition to the foregoing, there has been developed by the 300 level or lower tunnel, a body of ore carrying silver, lead and gold. This was encountered in the east crosscut and drifted on for 120 ft. It is only 18 in. wide where developed in the eastern crosscut, but gradually widens to 80 ft. A winze sunk to a depth of 45 ft. and a crosscut southeasterly shows a width of ore of approximately 80 ft. This crosscut was driven diagonally across the lode and shows a greater width of ore than the crosscut on the tunnel level.

There is a well-defined east-and-west fissure on the surface, which intersects a north-and-south fissure at about the point where this large orebody is developed and would seem to have had much to do with the abnormal swell at this point.

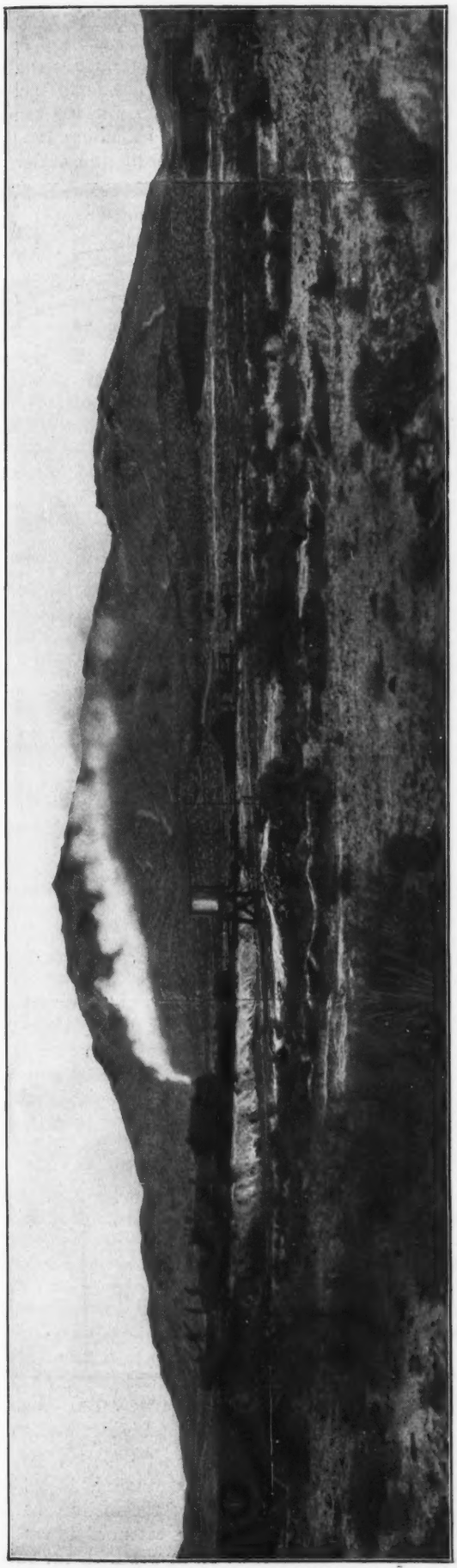
The developments in the Toulomne group consist of a short crosscut tunnel and a shaft approximately 40 ft. deep, from which samples range from 1.6 to 16 oz. silver, a trace to 0.06 oz. gold and ½ to 15.6% copper. The company is shipping from six to ten cars of ore per day and employing upward of 60 men.

Calaveras Group Development

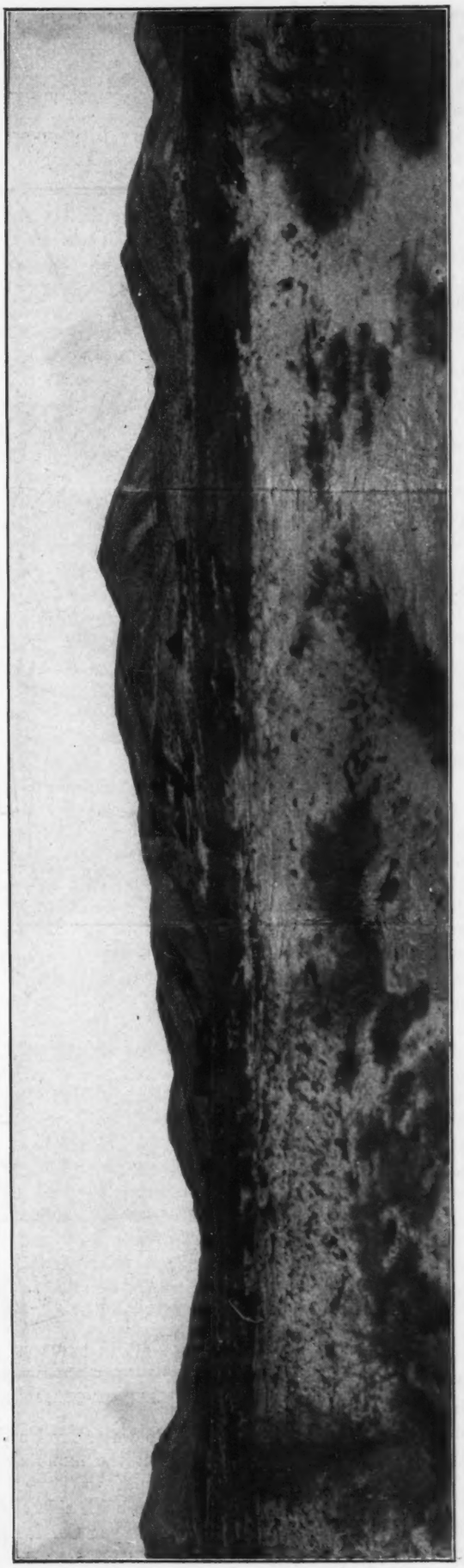
The Calaveras group is developed by two short crosscut tunnels, and shallow shafts the deepest of which is not more than 25 ft. Samples taken from these prospects show 0.11 to 0.20 oz. gold, 0.20 oz. silver and from 1.99 to 9% copper. The copper occurs in the form of chalcopyrite and bornite. Everything about the occurrence is normal. While this group can be classed only as a prospect, it is exceedingly attractive.

The developments on the Yellow Hammer group consist of three shafts, ranging from 25 to 50 ft. in depth, all of which show ore of good quality. Samples from the ore exposed gave 0.40 to 0.62 oz. gold, 1.40 to 3.80 oz. silver and 1.36 to 1.68% copper. In fact, both this and the Calaveras group can begin shipping in a small way as soon as the railroad is completed. The trend of the Deep Creek Mountains is practically north and south. There is evidence of quite extensive faulting parallel to the trend of the range. Granodiorite forms the center or core of the range, and it is flanked on both east and west by sedimentaries consisting largely of altered limestone with patches, or islands, of lime left on some of the highest points and on the slopes near the axis of the uplift. There is a series of andesite dikes which strike north and south and another series with the strike practically east and west. In many places on the surface merchantable copper ore is found along the andesite dikes or in close proximity to them. This is particularly true of the east-to-west dikes, and as the district is becoming better understood, developments are being made along the dikes with considerable success.

All the ore developed in the Gold Hill group is a replacement of limestone. This is also true of the devel-



PANORAMA, SHOWING THE TERMINUS OF THE DEEP CREEK RAILROAD, UTAH



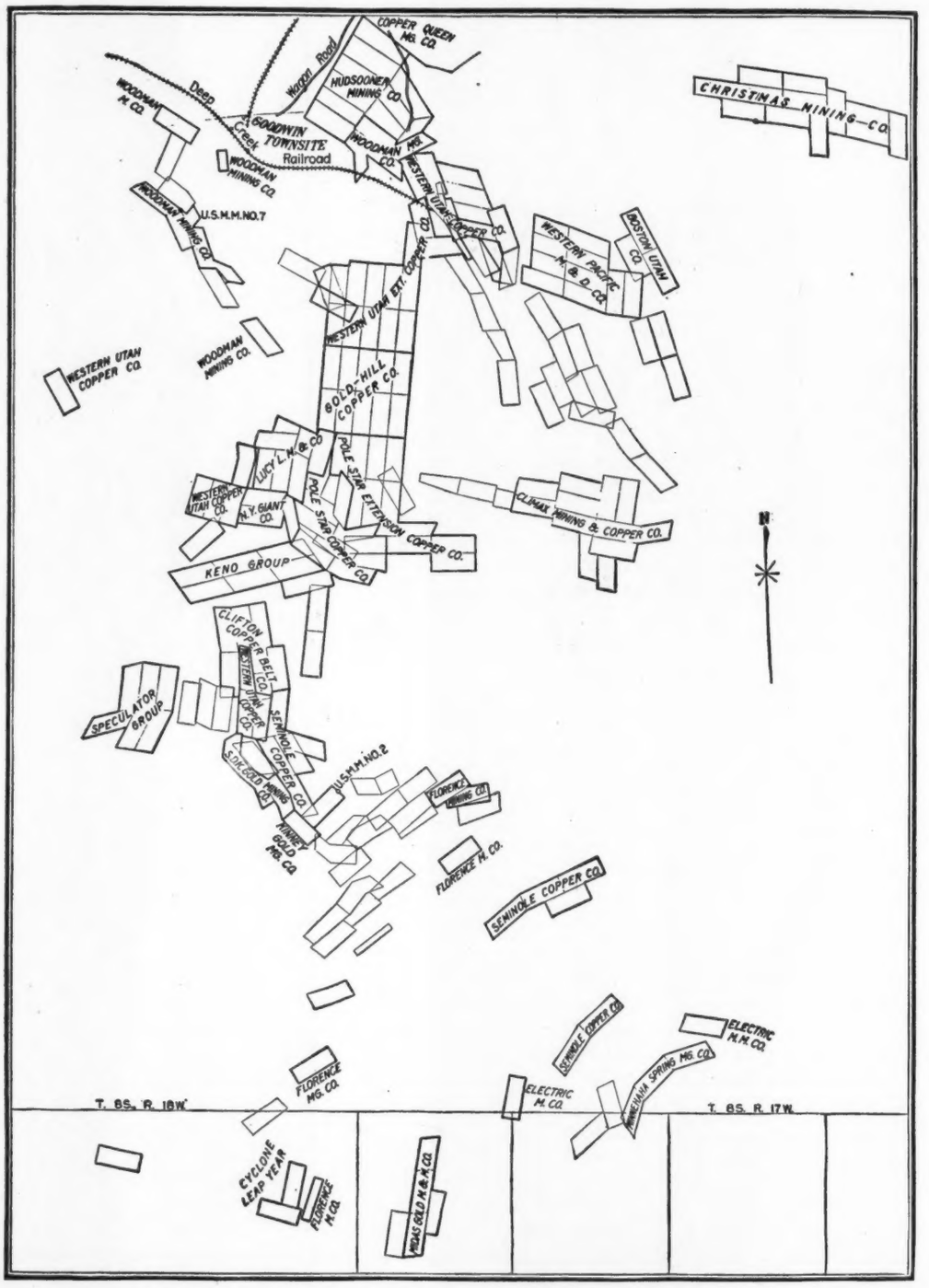
CONTINUATION OF THE PANORAMA, SHOWING THE TOWN OF GOODWIN AT THE TERMINUS OF THE RAILROAD

opments in the Toulomne group; but the ore in the Calaveras is in the igneous rock in close proximity to andesite dikes running both east and west and north and south. The ore developed in the Yellow Hammer group is also in the igneous rock.

Climatic conditions are excellent—very little snow in the winter, light spring and fall rains. There is an abundance of good water for culinary and boiler purposes within 19 miles of the district, which can be delivered at a comparatively low cost. This water is owned by the Western Utah Copper Co. and may be considered a valuable asset. The present developments on the four groups of claims owned by this company, both in the igneous and sedimentary formations, are encouraging. While there is no precedent to go by and no very deep workings, yet one cannot see any reason from the present developments why the ore should not continue in depth. The Western Utah Extension Copper Co. is arranging to install a compressor and hoist. One fissure crossing this property can be traced on the surface for a distance of over two miles in length and is from 3 ft. to over 50 ft. in width. In this distance it has been opened up with various tunnels, all of which show ore. In one place there are five tunnels, on the fissure, one above the other, which cut the formation. All these tunnels have developed shipping ore. The company plans to sink on this fissure to water level and at the same time to run a tunnel under the mountain, which will give from 450 to 500 ft. in depth.

The property comprises about 300 acres with side and end lines adjoining the Western Utah Copper Co. for a distance of about 3000 feet.

The Pole Star Copper Co. owns 15 claims (five of which are patented), containing about 229 acres of land. Developments consist of 10 opencuts, four incline shafts, five vertical shafts and five tunnels. The main incline shaft has been sunk 180 ft., and a main working tunnel of 100 ft. has been driven, which, by extending 180 ft., should reach the main shaft, thus affording an outlet by gravity for ore developed in the incline. In addition to the developments cited, another tunnel where a large tonnage of shipping ore has been developed, is being worked about 1200 ft. to the west of the incline shaft. This tunnel is in 350 ft. and is being extended to crosscut an outcrop which is 15 to 20 ft. in width on the sur-

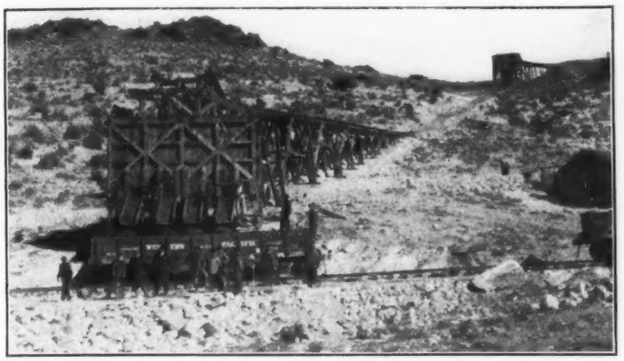


MAP OF CLAIMS IN THE DEEP CREEK MINING DISTRICT, UTAH

face, samples from which gave 7.3% copper, with pay quantities in gold and silver. In this tunnel 2 ft. of good ore has been encountered. This, however, is but a spur off the main vein, which, according to survey, will be cut in another 50 ft. The company is also prosecuting work at a point about 800 ft. to the east of the incline, where a cropping of silver ore has been discovered, samples of which gave results of 60 oz. silver per ton. To the south of the incline a silver-lead outcrop was sampled that gave 10.7% lead and 42 oz. silver per ton. Work on this outcrop will be commenced at once.

As a matter of fact, the mountain upon which the Pole Star copper holdings are situated, which is locally known as the "Lucky Day Knob," has numerous outcrops showing pay ore.

The Lucky Day Knob, is composed of granite, granodiorite and porphyry fissured easterly and westerly and containing large dikes of porphyry and monzonite running northerly and southerly, all being capped with limestone. So far, developments have shown that the



ORE BIN, WESTERN UTAH COPPER CO., DEEP CREEK DISTRICT, UTAH

ore makes in the easterly and westerly fissures, although the north and south veins or dikes are highly mineralized and development may find commercial ore.

The company is now building bunkhouses sufficient to house from 30 to 40 men and a cookhouse. At the mine a large ore bin is being constructed about 125 ft. below the incline shaft, connected with an ore chute and tramway so that the ore can be dumped automatically from the mouth of the incline; from the bin it will be taken to the railroad by teams.

At present, an incline shaft which has a dip of 32 deg. is being sunk. This incline has attained a depth of 180 ft. and is equipped with a gasoline hoist. All the ore being shipped by the company is mined in this shaft, which is the deepest in igneous rock in the district.

Several drifts have been run off the incline, and all are in ore. At the 180-ft. level a raise was made and an orebody was encountered, samples from which gave 22% copper, 14.20 oz. silver and $1 in gold. A drift has been run for about 15 ft. and shows ore in the top, sides, bottom and face. This strike of ore at this depth is an important one and has added quite a stimulus to deep mining in the igneous rocks. This ore was encountered at a vertical depth of 270 ft.

The Pole Star Copper Co. has another shaft in operation on a silver and lead vein, which crosses the property about 600 ft. to the south of the present incline shaft. Here the company is grading and putting in foundations for a compressor plant. That they are in earnest is evident from the energetic way in which they are pushing developments.

The Pole Star company shipped the first car of ore over the new line. The ore was hauled by auto trucks to the first siding on the railroad, known as Erickson's ranch, about 15 miles from the mine. The value of this shipment of 22 tons was something over $580.

In drifting on the ore after getting out this shipment, another vein, about six feet in width, was cut, containing bornite and chalcopyrite, together with some carbonates and oxides of copper, samples of which gave $106 gold, silver and copper per ton. In enlarging the drift and cutting through the hanging wall of the original vein, a showing of red oxide of copper was found, and samples gave 40% copper, $22 gold and 1 oz. silver per ton. This, however, is a small vein, ranging, as far as developed, from 2 to 8 in. in width. Another strike by the Pole Star company, made in a raise from the 180-ft. level of the incline shaft, is opened up for a distance of 11 ft.

Excavations are being made for the compressor plant that is to be installed at the new shaft. This will be the main working shaft of the property and is being sunk to cut the several veins on the property, at depth. So far this company has opened up and partly developed four different vein systems.

M. R. Evans, a prominent mining operator of Salt Lake City, owns 21 claims on Dutch Mountain, three miles west of Gold Hill. Twenty of these claims are in one group while the twenty-first, known as the "Old Shovel," is not over 800 or 1000 ft. from his other holdings in that section. Altogether, over 1200 ft. of work has been done in the development and exploitation of these claims, all of which are patented. Much of this work was done in ore both of shipping and milling value. As soon as possible this property will be equipped with a gasoline engine, hoisting plant and air compressor. At Ferguson Springs Mr. Evans also owns a group of five patented claims in the workings of which there is a showing of commercial ore. It is more than likely that development of this group will be resumed this spring.

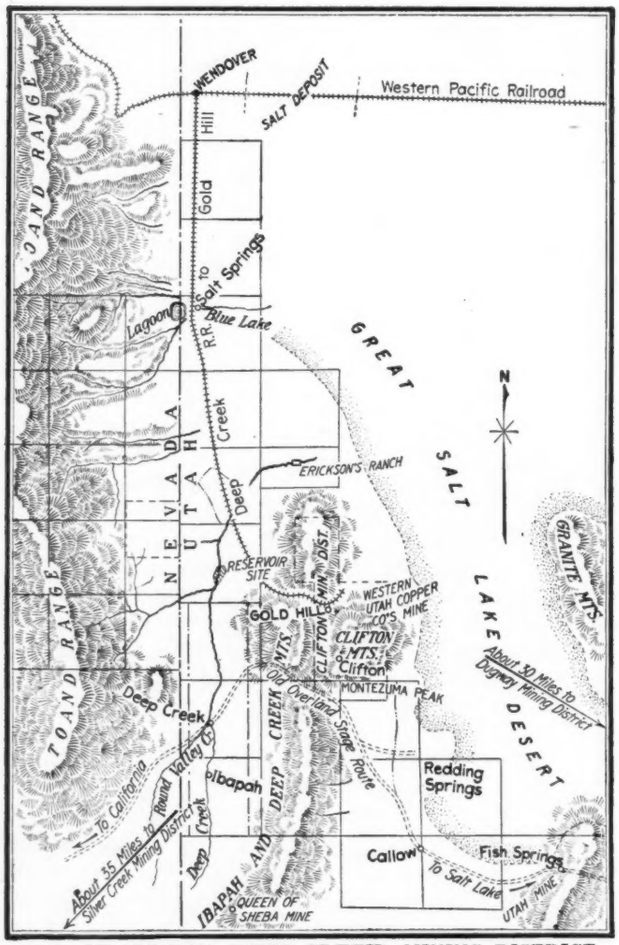
The Old Queen of Sheba Mine

The Queen of Sheba mine, embracing a group of ten claims, six of which are patented, is situated 15 miles southwesterly from Gold Hill, the present terminus of the new Deep Creek R.R. This property is on the west side of Mt. Ibapah, at an elevation of 10,000 ft. It is an old gold producer of note, and while being operated under the most trying circumstances on account of the long distance from market and high transportation charges, it has been profitably worked from time to time and has lately been equipped with a first-class surface plant and reduction works, power plant and assay office. A 10-stamp mill has treated by amalgamation quite a tonnage of $10 to $100 ore, and it is estimated that all of 50,000 tons of this class of ore is showing in the mine workings. It is stated, however, that the milling plant is to be remodeled and that a new system of treatment will be introduced at an early day. To connect the mine with the mill an aërial tramway may be constructed, and new machinery is to be installed wherever needed. The fissuring has a strike northeasterly and southwesterly, and the ores range in width from 5 to 70 ft. The mine is electric-lighted and up to date.

The Garrison Monster Mining Co. owns a group of 27 or 28 patented claims. There are showings of silver-lead ore in many places on the property, development work having been under way for many years. The first locations were made as early as 1882. There is an abundance of fine spring water on the company's holdings, both for culinary and milling purposes. This group is considered as having great possibilities with increased development.

The Climax group of 12 patented claims, owned by the Climax Mining Co., has a 150-ft. shaft and about 250 ft. of drifts and crosscuts, much of the workings being in shipping ore. Two cars of 27% lead and 29 oz. silver ore were shipped several years ago by team.

The Sunshine group consists of six claims, only assessment work having been done on this group since location several years ago. The Blackbird group of four claims adjoins the Gold Hill. It has a good surface showing. The Copper group, consisting of 15 claims, is held by locations. The only development done on this promising property has been the annual assessment work. Copper ore has been found in considerable quantities, running as high as 20%.



MAP OF CLIFTON (DEEP CREEK) MINING DISTRICT, UTAH, SHOWING RAILWAY LINE

The Maple group, consisting of eight patented claims, one mile south of Gold Hill, is developed to a considerable extent, having a fine showing of lead-silver ores. The Copper Cloud group, consisting of six or eight claims, is well situated. Only the assessment work has been done thereon from year to year, since location. This is a lead-silver proposition. The Success group consists of four patented claims. There is a car of lead-silver-copper ore now on the dump at this property awaiting shipment.

The Mammoth group consists of six unpatented claims on which the annual assessment work has been done from year to year since locations were made.

A New Source of Platinum

According to the Bulletin of the Siberian Engineers' Society, reprinted in the *Chemical Trade Journal and Chemical Engineer*, Apr. 28, 1917, on the platinum fields of the Nizhni-Tagilsk Mining Circuit, V. N. Tchorzhevsky has begun the first experiments on the extraction of platinum from dunite. The platiniferous nature of dunite was long ago observed, and the presence of the metal is apparently connected with the existence in the rock of chrome iron ore.

All this was known before, but was rather of scientific interest; and it is only now that the investigation of the dunites for platinum on a wide scale is being undertaken, in order to prepare a plan for utilizing the immense reserves of dunitic rocks that in the Nizhni-Tagil district alone occupy an area of 11.7 square miles. The method of extraction adopted is the simple grinding, under runners, of the rock, and the collection of the chromitic slack, and then a fresh grinding of the latter in order to leach the pure metal finally from it. The chromitic slack remaining after washing the platinum sands being scrupulously cleared of all visible platinum, yielded with an experimental grinding by runners, in the month of March, when it was still impossible to deliver dunites to the factory, over 200 oz. of metal out of 9720 lb. The gray slack, which consists chiefly of undecomposed dunite obtained from the dredges when washing platinum, yielded 2.6 zolotniks (11 grams) of metal from 3600 lb.

Automobiles and Gasoline

In an address before the American Chemical Society, Dr. Rittman said that by July 1 there will be 4,000,000 automobiles in operation in the United States. The address was written before the declaration of war, but he predicted that when materials reach normal prices again the costs and consequent selling prices will be so reduced that 10 million cars will be the automobile census of this country at its present population. This means an annual replacement of 2,000,000 machines. Only the steel, lumber and clothing industries exceed the automobile business today. The annual bill for the upkeep of motor cars now operated in the United States he places approximately as follows: Gasoline, $500,000,000; tires, $500,000,000; accessories, $300,000,000; garage hire, $150,000,000; repairs, $150,000,000; total, $1,600,000,000.

The number of automobiles in this country on Jan. 1 of each of a number of years past he gave as follows: 1905, 85,000; 1910, 400,000; 1915, 1,754,000; 1917, 3,250,000; 1918 (estimated), 4,750,000.

The average consumption of gasoline per machine per annum is placed at 500 gal., besides the use in motor boats, motor cycles, farm engines, chemical manufacture, cleaning establishments, etc. Therefore, the fuel problem is the big one for automobiles. Alcohol he puts down as a commercial possibility when gasoline reaches 35c. a gal., but not before. This considers alcohol at before-the-war prices.

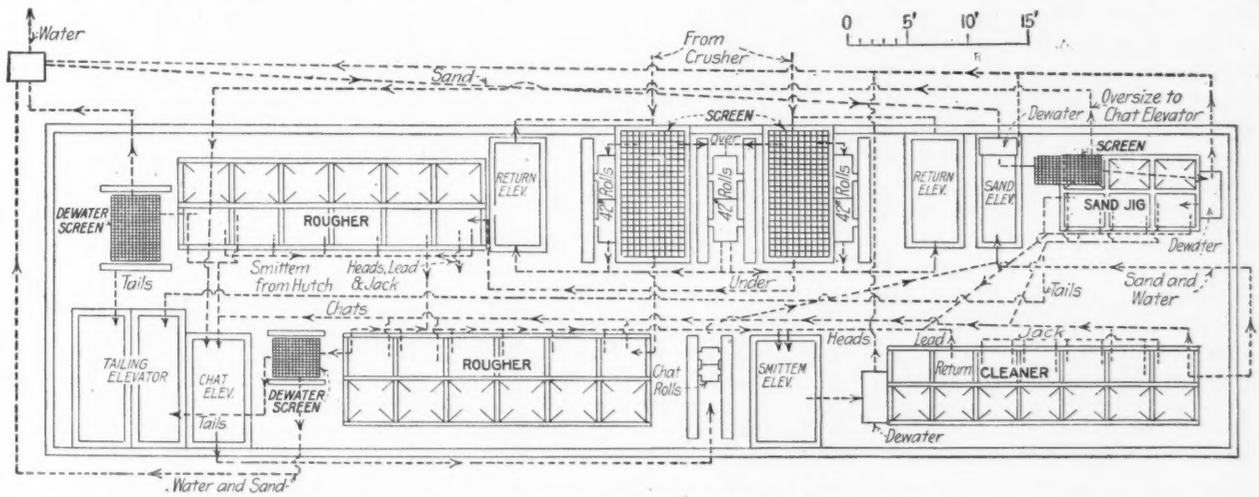
The Media Mill, Webb City, Mo.*

SYNOPSIS—A new, large zinc mill, built to take advantage of market conditions by heating an ore previously considered too low in grade to handle. The installation was paid for in four months of operation, and is so planned that it will be able to run under normal conditions for zinc ore.

The unprecedented high price of zinc ore prevailing through the early months of 1915 caused great activity in the Joplin district of Missouri. The Media mill is conspicuous as one of the first of the new "big mills" of the district. The mill was built over a mine previously worked, but abandoned in 1912 because of the leaness of the ore and the large quantity of water encountered. The ore prices prevailing—$100 a ton in June, 1915, as against $50 in 1912—favored the new undertaking. The mill was designed for good recovery so that it might operate in times of depression. In design and equipment the mill is exclusively local in conception and construction.

The mill equipment included two 12 x 18-in. Webb City crushers, 400 r.p.m.; two 8 x 4-ft. Webb City trommels, extra heavy fittings, 20 r.p.m., jackets with 0.5-in. holes; three 42 x 16-in. Webb City rolls; two return elevators, 22-in. cups, 18 in. apart on belt over 30-in. pulleys at 40 r.p.m.; two 6-cell rougher jigs, Cooley type, $\frac{1}{8}$-in. grates on 48 x 42-in. cells, 95 r.p.m., 3-in. drop between cells, plunger stroke graded from 2.5 to 1.0 in.; two 48 x 48-in. Ford-type dewatering screens, belt suspension, 8 r.p.m.; two tailing elevators, 20-in. cups on 20-in. belt over 30-in. pulleys; one smittem elevator, 20-in. cups on 20-in. belt; one chat elevator, 20-in. cups on 20-in. belt; one sand elevator, 20-in. cups on 20-in. belt; one chat roll, 30 x 14 in., Webb City make; one 7-cell cleaner jig, Cooley type, $\frac{1}{8}$-in. and $\frac{1}{12}$-in. grate slots on 36 x 48-in. cells, plunger stroke 140 per min., 1.5-in. drop between cells, plunger stroke from 1.25 to $\frac{3}{8}$ in.; one 36 x 72-in. sand trommel, 2-mm. holes; one 3-cell sand jig, Cooley type, $\frac{1}{12}$-in. grates on 36 x 36-in. cells, 175 strokes per min.; 1.5-in. fall between cells, stroke from 1.25 to $\frac{3}{8}$ in. in length; one 6-in. Swaby centrifugal pump, 600 r.p.m.; one 2.5-in. American Well Works centrifugal pump to supply water to crushers.

Cross-compound, 15 x 30-in. cylinders and 48-in. drum steam hoist, 2-ton skips, in balance, capable of round trip each minute, sheaves 110 ft. above ground, grizzly bars of 60-lb. rail spaced 5 in. apart on incline, 0.55 in. for flat rails; three 20 x 30-ft. concrete tanks, diagonally inclined bottom to outlet 10 ft. deep; sand-plant building 60 ft. square with flat trussed roof, elevators extending up through roof; originally equipped with feed, return and tailings elevators (return elevator removed after trial showed the man in charge that the 11 tables did not give enough middlings to bed even one table); tables as follows—three wooden decks, Lycans & Stilwell, two linoleum decks, medium, Lycans & Stilwell, three linoleum decks, fine, Lycans & Stilwell, one linoleum deck, slime, Lycans & Stilwell, two ford slime tables, inclined vibration; elevators 4 ft. width with 20 x 30-in. pulleys, direct-geared and belted to make 45 r.p.m., 16-in. cups on 16-in. belts; trommel after feed elevator, 36 x 72 in., 1.5-mm. holes; hindered settling classifiers 1 to 3 ft. deep along overhead trough for first eight tables, wooden construction; three 6-ft. thickeners on floor at head of each slime table; 4-in. centrifugal pump; tables driven by 4-in. belts over 14-in. pulleys to approximate 245 strokes on coarser tables and 270 strokes per minute on slimers.



TREATMENT DIAGRAM OF THE MEDIA MILL, WEBB CITY, MO.

Some of the more general items are shown in the table.

MILL CONSTRUCTION COSTS

Labor, mill construction	$8,100
Lumber	8,000
Equipment, general, mostly in mill	12,000
Supervision and office	1,500
Cement	1,200
Pond and ditch to mill	1,860
Generator for lighting	600
Compressor	7,500
Labor, power and water installations	1,350
Boilers with fittings (first 4)	5,800
Brick and clay	950
Office supplies	70
Tools	500
Insurance during construction	1,500
Concentrating tables	2,400
Painting, material and labor	350
Mill engine (first engine)	650
Hoist engine	925
Condenser and pump	960
Belting	2,500
Approximate cost of plant	$58,715

*Excerpts from an article by H. B. Pulsifer, in the "Bulletin" of the American Institute of Mining Engineers, May, 1917.

much again was expended in draining the mine, enlarging the shaft and excavating the underground hopper for the skips, and for the mine equipment. Figuring a daily capacity of 1500 tons and 300 working days a year, the plant cost amounts to about $40 per ton of daily capacity, or about 14c. per ton of annual capacity. It is interesting to note that after the mine began to produce a respectable tonnage, the first month in 1916, only about four months' operation sufficed to yield a net profit equal to the entire outlay for plant and mine.

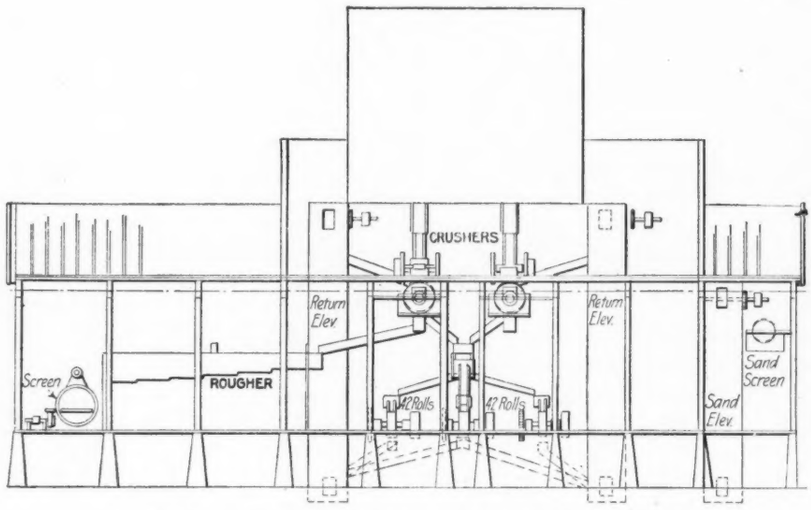
The Media has continuously ground 1200 tons in 20 hours in its single jig room. On occasion, 1800 tons has been treated without difficulty in 24 hours. The capacity has, up to this writing, been limited more by conditions inside the mine than in the mill. The Media hopper is by far the largest ever erected in this district. It holds, without leveling, 1200 tons, and rests on thirty-six 24-ft. posts, which in turn rest on a massive foundation joined to the concrete lining of the upper shaft. In my opinion the derrick is far too light for the load and acceleration commonly used, for the vibration at the sheaves during hoisting is considerable. The upper tier of 10-in. posts was never crossbraced, and those on the east side of the hopper toward the hoist, which is on the north side. The uprights on the side of the bin remained vertical, but this edge of the floor had shifted approximately 6 in. before it was noticed during the spring of 1916; the movement then apparently ceased, for the measures taken could not possibly have restrained further progress in this twisting of the floor.

A large pond was constructed at considerable expense; the enormous output of tailings and sand was allowed to encroach until within a few months the effective pond capacity had been reduced to meager proportions. Such management is characteristic of the district.

The three thickeners in the sand plant were overflowing on one side only, at the time of my visit in May, 1916. The settling tanks were designed with the intake at the shallow end so as to permit a continuous flow from the deep corner to the tables—a sort of combination of intermittent tank filling and continuous thickening. The local operator, however quickly changed to the customary way, filling the deep end with sand, making it a wholly intermittent operation. It has already been mentioned that the return elevator was discarded, the middlings being put in the main stream again. These three instances indicate the strong retrograde impulse that is so highly characteristic of the district.

The mine rock has run fairly uniformly a little over 2% in mineral recovery. The mineral content has averaged about 4 tons of jack to 1 ton of galena. As the tonnage can probably be kept high and the mill has several strong features for unusual recovery, the venture promises well even during periods of low ore prices.

The best features of the ore dressing may be enumerated: Main tonnage fall direct from hopper to tailing elevator; only oversize is reëlevated; bad turns in main stream nearly absent; splendid balance of unit capacity; no one unit crowded or choked while others are running light; if any capacity weakness develops it will probably be in the cleaner, chat regrinding or sand units rather than in main tonnage units; the cleaner is of unusual size, only a very few of this size ever having been built in the district; ample facilities for dewatering sands and a sand jig in the main mill to treat cleaner sand and ground chats (settled rougher sand can also come back to this jig) relieves the roughers; the sand plant is entirely separate from the jig room, as is now fairly customary in the district, and has an equipment carefully selected and capable of excellent work; mill water is ele vated no higher than necessary, a second small pump supplying the high line to the crushers; the main tonnage flow is through twin units; this arrangement is happily



LONGITUDINAL ELEVATION OF THE MEDIA MILL

combined with large single units on the enriched segregate; both streams being in the closest possible proximity, elevator fronts being open and nearly every unit being in full view, minimum attendance is required and instant response to mishap is possible.

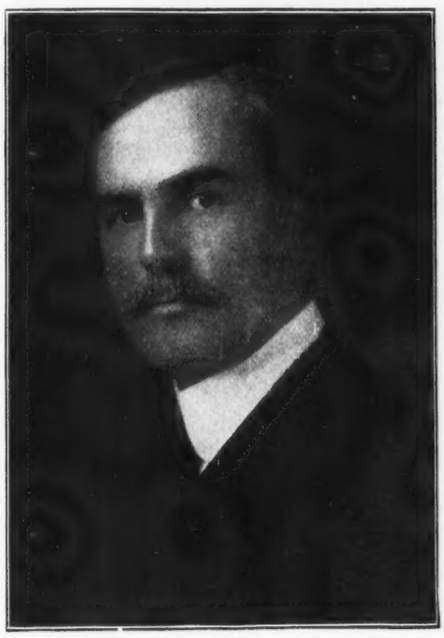
The greatest disadvantage that has come to my attention is the undue crowding in the jig room. The elaborate tangle of shafting, belts, spouts and pipes is unsatisfactory, and unhandy when repairs are required.

Full use is made of the principle of equipping only with units carried in stock by local supply houses. Repairs are thus most fully assured for instant delivery.

I believe this principle of local inheritance was decidedly overdone. A glaring instance is in the case of the tailings disposal—within a very few weeks the great tonnage had built the pile right up to the spout and the customary "dummy" elevator became necessary. Tailings disposal, as abundantly demonstrated in various other localities, could much better have been installed.

The inevitable inquiry as to the application of flotation is answered by saying that no adequate demonstration of its successful application has yet been made in the Joplin district. At another plant I made experiments on the recovery of jack from the fine waste sludge. Preliminary tests indicated that it would not be difficult to obtain a froth product containing over 40% zinc. However, the present practice is so firmly established that it will be difficult to convince operators of the desirability of adopting flotation on a large scale.

Chairmen of Sub-Committees on Raw Materials Appointed by Advisory Commission to Council of National Defense



JOHN D. RYAN
Anaconda Copper Mining Co.

CHARLES F. BROOKER
American Brass Co.

A. C. BEDFORD
Standard Oil Co. of New Jersey

EDGAR PALMER
New Jersey Zinc Co.

History and Legal Phases of the Smelting-Smoke Problem*—II

By Ligon Johnson†

SYNOPSIS—As smoke suits began to multiply, plant managers, not knowing how much damage was actually done to vegetation by smoke, were forced into paying damages that resulted only in creating a class of "Smoke-farmers." This blazed the way for smoke engineering and research work was begun including chemistry, plant pathology and physiology, entomology, agronomy, dairy husbandry, and veterinary toxicology and meteorology. Sulphur found to be under some circumstances not injurious but beneficial to vegetation. Where there is fume injury the answer to the problem is in hot gases, gas dilution and high stacks.

Shortly after the time the Selby Commission began its work, the murmuring of discontented farmers become much louder. Crops had failed in many places, and wherever this crop shortage was in a smelting locality the smeltery was blamed. This was particularly true where prior payments had been made to farmers. Peace was quoted at war prices.

This was very shortly after the Selby Commission began its work. Other than the research just beginning under the Selby Commission, there had not been in the United States or elsewhere any experiments or research work with smeltery fumes or SO_2 under natural field conditions. It is true that Haselhoff and Lindau, Von Schroeder and Reuss, E. Schroeter, Wieler and Hartleb, R. Hartig, Wielencenus, Freitag, Sorauer, Ramaun, Gerlach, Schmitz-Eumond, Sabachnikoff, Raubner and Stockhardt in Europe, and Haywood and Pierce and, to a limited extent, Ebaugh and Talmage in the United States had carried on some experiments, but in none of these were normal field conditions approximated. Some fumigations were carried on with leaves or twigs or small parts of plants in bell jars. Others were in hermetically sealed cabinets or "smokehouses" so constructed that only abnormal conditions could result. The plants used were grown in pots or flats and were grown and kept under conditions that were not normal. The fumes introduced were from burning sulphur or sulphur and alcohol, or else concentrated SO_2 let in from a tank or gas burette. The concentrations were unknown, absorption was not considered nor were chemical analyses of the air made. Environmental factors of temperature, humidity, light values, barometric pressure and time element of exposure were not considered. The plants used in the experiments were not grown to maturity, nor were their food or crop values ascertained. As a matter of fact, at the time these experiments were conducted, no quick and accurate method of air determination was even known to the experimenters. Even had these investigations been conducted with normal plants, under natural field conditions, the lack of knowledge or records of actual fume strengths reaching the plants and of the environment factors involved would have rendered the experiments practically valueless.

Some investigators of smeltery regions placed much reliance on the sulphur content of plants collected in smelting neighborhoods, notwithstanding the fact that investigations in the Department of Agriculture have shown that the sulphur content of the same plant may carry as much as 3000% at different times during the season and at the same period the content of the same species of plant will vary markedly, particularly under different percentages of soluble sulphur in the soils, which frequently occurs at short distances.

In other words, from farmers and experts the smelteries were coming in for full blame for all crop failures and the managements actually did not know whether or not they were doing the damage. From my past experience I knew that there were numerous plant injuries attributed to smeltery smoke which even the most competent expert could not differentiate by mere observations or even microscopic study. Numberless diseases and injuries that were not caused by smeltery smoke were pointed out as evidence of smoke damage.

No plant manager knew how much, if any, of the damage attributed the smeltery was caused by it, and if there was damage, that operation of the smeltery or element of waste had produced the damage. And, too, with the payment of damages communities of smoke farmers grew up. Their idea of farming was to let their places grow up on weeds and collect from the smeltery the value of the maximum crops ever produced. Many smelters had paid damages for conditions which, if later developed, were not remotely attributable to smelting operations; but the farmers once having been paid, insisted on continued payments. The price of peace was rising above the possible profits of smelting operations.

The time for theorizing had passed. It was necessary that the smeltery managements should know just what damage was being done, and if there was damage, how it was done and what was necessary to prevent it. Under my urgent recommendation, the first research department to ascertain all this was installed and, in conjunction with the Selby Commission, it blazed the way for the smoke engineering.

Beginning of Research Work in Smoke Engineering

This research work involved chemistry, plant pathology, plant physiology, entomology, agronomy, dairy husbandry and veterinary toxicology and meteorology. One might wonder why all this was necessary just to find out whether or not the smeltery was doing any of the things claimed, and why one or two experts familiar with the appearance of vegetation in smeltery regions would not have sufficed. It was necessary to know first what smeltery fume or parts of fume would do damage; how the injury could be caused; what conditions were or could be confused with smoke injury, and finally, where damage was or could be done, what steps were necessary to obviate it.

This meant extensive research work under normal field conditions to ascertain the effect of smeltery eliminations

*A paper originally presented at a meeting of the New York Section of the American Institute of Mining Engineers, Jan. 26, 1917; to be formally presented at the St. Louis meeting, October, 1917.

†New York, N. Y.

upon vegetation and animal life. Suffice to say that it was found that dust and acid vapors were practically negligible quantities in the fume problem so far as vegetation was concerned. Where damage was done, this could be traced largely if not wholly to sulphur dioxide. The average vegetation can stand fifty times the strength of acid vapor that it can resist where the sulphur is administered in the form of SO_2. In the average smeltery fume the acid vapor is but a small fraction of the sulphur content, the latter being chiefly confined to sulphur dioxide.

It then became necessary to ascertain the relative resistance of the various plants to sulphur dioxide and the conditions under which injury occurred when the SO_2 was present in sufficient quantities to do damage. To develop this fact it became necessary to know exactly how smeltery fume acted upon plant life, how it obtained ingress to the plant structure and its effect after its absorption in the plant.

It may not be amiss just here to describe in a few words how this ingress comes about and the results which follow. In the beginning it was found that only during the period that the plant was in leaf could injury occur. Subjecting a plant to SO_2 or other fume while not in leaf produced no result. In most instances, and practically without exception in alkaline soils, we found that treating the soil with sulphur or sulphuric acid—that is, dusting or spreading crude sulphur upon the soil or spraying the soil with acid—resulted in increased crop yield. Sulphur administered in this way was a benefit and not an injury. This conclusion was verified by independent experiments conducted at the University of California in Berkeley, at an experiment station in Oregon and at the experimental farm of the Anaconda Copper Co.

Effect of Fume on Leaf Structure

The question then narrowed down to the effect of smeltery fume through leaves and on leaf structure and to present this clearly it is necessary to describe the ordinary leaf and its functions. All leaves under normal field conditions, in climates such as have to be dealt with here, have an epidermis covering both under and upper leaf structure. This epidermis is impervious to moisture and for all practical purposes, except where stomata, or breathing pores, occur, is also impervious to gases. These breathing pores are so small that considerable magnification under a microscope is necessary to see them at all. The stomatal openings are entirely too small to admit the minutest suspended water globules or particles of mist or vapor. The stomata at the leaf surface are faced with two guard cells, that are also covered by practically impervious epidermis. These guard cells, under certain leaf functions open or close the stomatic chamber. With the guard cells closed, the leaf under ordinary conditions presents impervious surfaces to the elements. The inner content of the leaf, or the mesophyle, is composed of palisade cells, collecting cells and sponge parenchyma, in which, under the action of light, starch and sugar are formed and plant food manufactured and supplied to the plant.

We next found that under conditions of absolute closure of the stomata the plant was a number of times more resistant to SO_2 than when the stomata were open. Under all ordinary conditions the stomata form the points of ingress of gas. It followed, therefore, that where an external condition brought about the closure of the stomata it brought about increased resistance, and we finally worked out four factors in chief in fume injury, where sulphur dioxide is present in strengths sufficient at any time to bleach plant life, these factors being light (the stomata are closed during the darkness) humidity, temperature and constant wind direction. The bearing of the last comes from the fact that injury, except from abnormally strong fumes, does not come from mere fume puffs but from steady application of SO_2 for several hours. The other three factors bear upon stomatal opening.

After we had learned the strength of SO_2 necessary to produce markings upon plant life under field conditions, it became necessary to know whether or not SO_2 was present in such quantities in the field. It was also necessary to know accurately the wind constancy and direction, the limits of the smoke stream, temperature, humidity and general weather data. Complete installation of standard weather instruments, under the supervision of the local United States inspectors was made; and portable laboratories—that is, laboratories set up in small automobiles which could follow the smoke stream as well as make general tests—were secured. This was in addition to the fixed air stations maintained. Under the method of air analyses devised by J. R. Marston and later refined by A. E. Wells, chief chemist for the Selby Commision, quick and accurate determination of air samples was possible, and, more important still, these samples could be taken in a few seconds, and, in this way, the constancy or inconstancy of the SO_2 determined. For the smelting plants, the several flues at the base of the outlet stacks and the stacks were cross-sectioned to afford analysis of their contents, and self-recording thermometers were installed at appropriate points in the flues and stacks for accurate and complete data as to gas temperatures.

Cause of Crop Failure Determined With Scientific Exactness

With this knowledge, the next step was to ascertain with scientific exactness the cause of crop failure or injury where the appearance of external conditions, and often even microscopic cross-sections, were seemingly identical with the results of smoke injury, but where our other investigations had developed that smoke injury, could not have occurred. There are many diseases, pathological conditions and insect injuries which, both externally and under the microscope, present an appearance practically identical with that of smoke injury. With the completion of this investigation, a survey of the entire so-called fume zone followed.

It is interesting to note that, in determining the injury of plants by disease, diagnosis can be established with scientific exactness not possible in the diagnosis of any disease of human beings or animals. Diagnosis can be established beyond the possibility of doubt or question. This is done by what is known as the pure-culture method. The unhealthy plant is pricked by a needle-pointed instrument which is then dipped into a special and pure plant jelly, and a culture of the disease organism is grown. The disease organism is isolated with this culture, and after the disease develops, comparison of appearances is made; a second culture is made from the innoculated plant, and a second innoculation of a healthy plant follows. In this way the disease organism is iso-

lated, the disease and appearance reproduced and the diagnosis established beyond a reasonable doubt. For insect causes, the causative insect is found and collected As some insect colonies, although numbering thousands or even millions, are so small that the individuals are observable only under very high-powered microscopes and others work wholly out of sight and beneath the soil, it requires a competent entomologist to handle this phase.

One other agency in smoke determination has been established with relation to plant life, and that is the evidence of so-called guide plants. There are certain plants, such as barley, which are especially susceptible to fume injury and will show bleaching long before the possibility of injury to other plants. Where the guide plants are unmarked, it is self-evident that the trouble with adjoining hardier plants is not smeltery smoke.

In the work mentioned, there was secured information, valuable to the smelters, and actual and beneficial conservation so far as the agricultural resources of the country were concerned was accomplished. Scientific farming is not yet widely practiced. Farming methods are often handed down from father to son. Year after year the same crops are planted, often on the same soil. This applies to farming generally and not merely to smelting communities. In many places not only do the soils become impregnated with disease-producing fungus and germs, but the result becomes so widespread that no healthy seed can be secured in the community. It often happens that disease conditions may be largely eradicated by proper treatment and planting of the seed and crop cultivation, but these facts, as well as that the seed is diseased, are unknown to the farmer.

Investigation of a Potato Crop Failure

In one case enormous claims for loss of potato crops were filed against a smelter. Upon investigation it was found that both the potatoes and the soil of the region were highly infected with two of the most disastrous of potato troubles, rhizactionia and fusarium. A subsequent search of the seed stores in the community failed to disclose a single healthy sample of seed. Naturally the potato crops were failures. The sad part of it was that there was no need of this loss. Healthy seed procured elsewhere and planted in soil where potatoes had not been grown for several years would have given the old-time record crops, and proper treatment of the local seed would have produced infinitely larger returns.

Most of the diseases and insect conditions of agricultural communities are largely preventable, and for those that are not steps may be taken to greatly reduce the harmful effect. Much of the trouble can be directly pointed out to the farmer, and the means of eradicating or lessening these troubles shown him. This, of course, involves the demonstration that the unhealthy crop conditions are not attributable to the smeltery. The farmer who follows the suggestions for eradicating unhealthy conditions soon finds his crops exceeding those of his neighbors who have failed to observe the same precautions. In this way, gradually, it is true, the influence of the smelter's experts is felt, a friendlier feeling is engendered, agricultural conditions are improved and actual conservation accomplished.

This brings us down to one final theory which in some places is still firmly entrenched and threatens possible trouble—visual clearance and the belief that anything seen coming from a smeltery stack should be labeled with a skull and crossbones. Investigations showed that the visible fume was little to be feared as an actual instrument of damage to vegetation. Under former operations, where a good part of the lead content of the ore was blown up the stack and where heavy arsenic fumes were given off, this metallic loss had some connection with certain animal troubles, but had little effect on vegetation. Where this character of loss was not involved, the visible fume was and is chiefly dangerous from the psychological point of view. By this is meant that most farmers (and many will be honest in their belief) will assert, so long as there are visible stack emanations that every crop failure is due to smeltery fumes. Therefore, to meet this, it will be advantageous to obtain the greatest possible clearance up to the point where the efforts to secure visible clearance renders the smelting operation more likely to do actual damage. Beyond this point it is better to try to educate the farmer and get rid of the belief. Just because a farmer sees dense volumes of soft-coal smoke pouring from the stacks of manufacturing plants, business houses, engines and the like, he feels no uneasiness about his crop. There is little, if any, more danger to crops in the visible smeltery smoke. And, too, even where the belief of damage is deep-seated, mere belief can be met by facts, but actual damage cannot be dodged because the smeltery management seeks to meet some psychological condition; for mere belief will not last long in the face of actual damage.

Get clearance first for actual recoveries, and loss of toxic solids, and next, so far as possible, to meet any psychological conditions, but do not place visual clearance above the likelihood of actual damage.

Answer to the Problem of Fume Injury

Investigation and the temperature curves worked out have shown that where there is fume injury, the answer to the problem is in hot gases, gas dilution and high stacks. Anything that cools or slows down the gases or results in their liberation at low altitudes invites, to say the least, the probability of actual damage. Promising a community complete visual clearance or encouraging the belief that visual clearance means impossibility of damage is borrowing trouble for the future, for such a clearance means low gas temperatures.

These smoke problems are bringing to the front a new specialist, the smoke engineer. The far-sighted smeltery management, under existing conditions, for all new constructions, and even alterations and additions to old plants, will find this new expert a necessity rather than a luxury. The best way to take care of trouble is to prevent its starting. Many of the smelters realize this and welcome the coming of the smoke engineer and specialist.

British West Africa Gold Output

The total gold output of the Gold Coast Colony (the siugle British West African colony having gold mines in operation) in 1914 was 419,510 oz., in 1915, 412,273 oz., and in 1916, 389,068 oz., according to a notice published in *Commerce Reports,* Washington, D. C. For 1916 there is a decrease of 23,205 oz. as compared with 1915, and one of 30,442 oz. as compared with 1914, but it appears that these decreases are due entirely to conditions brought about by the war.

Engels Copper Mines, California

By Lewis H. Eddy*

SYNOPSIS—The Engels Copper company installed the first all-flotation plant in this country. A new mill when completed, will handle 3000 tons per day. The Indian Valley R.R. now completed, provides adequate service for mines which, by wagon haulage, have produced sufficient copper to build road and pay dividends which in 1916 amounted to approximately $150,000.

The flotation equipment of the Engels Copper Mining Co., in Plumas County, California, is being increased in capacity from 500 tons to an ultimate 3000 tons. The present mill of 500 tons, known as the upper, or Engels plant, installed in 1914, was the first all-flotation mill built and operated in this country. This plant will first be increased to 650 tons by the installation of a Hardinge mill 8 ft. x 36 in. The company has begun the erection of a new mill known as the lower, or Superior, plant, about two miles from the present mill. The first unit of 750 tons will be completed by September, 1917. Additional units of like capacity will be installed, and the Engels mill will be removed to the Superior plant completing the total of 3000 tons. The operation of a plant of this size will be necessary for the full extraction and treatment of the ore already developed, plus the reserve indicated by diamond drilling and prospects of development to follow further exploration.

The mill equipment will be wholly new and modern in every feature, representing the latest practice. It includes one No. 8 gyratory of 2000-tons' capacity and one 1000-ton No. 5 gyratory; two 8 x 6-ft. ball mills, working in open circuit with Dorr classifiers and two 6 x 12-ft. ballpeb mills in closed circuit with classifiers, designed to reduce the ore to minus 100-mesh. The concentrate will be passed direct from the flotation levels of the mill to the storage bins and loaded direct into the railroad cars beneath the bins, saving the expense of rehandling and sacking. The mining equipment is also modern or being modernized as conditions permit. Two compressors are being added, of the Ingersoll-Rand type, with a combined capacity of 4000 cu.ft. per min. They will be driven by two 400-hp. synchronous motors and will treble the present capacity, advancing the development work materially.

The construction of the new Indian Valley R.R. now completed, is a factor essential to the economic completion of the maximum mining and milling equipment and the continued profitable operation of the mines on an extensive scale. The railroad is standard gage, connecting with the Western Pacific at the new station of Paxton, three miles west of Keddie, and provides direct transportation from the mines to the smelteries at San Francisco and Salt Lake and through rail communication with Eastern points. The mines are situated in Lights Cañon about 16 miles northeast of Paxton at an elevation of 5000 ft., or about 1800 ft. higher than Paxton. The distance by the railroad is 22 miles, or five miles shorter than by the wagon road from Keddie. The roadbed is built on a maximum 4% grade for several miles through Indian River Cañon. The remainder of the road is practically level. This grade provides an easy downhill pull for the mine and mill products.

MILL OF THE ENGELS COPPER MINING CO. IN PLUMAS COUNTY, CALIFORNIA

*Associate editor, 3430 Peralta St., Oakland, Calif.

The heavy snows and exceptionally stormy weather of last winter greatly retarded construction, but in January the railroad had reached Crescent Mills, eight miles southwest of the mines, and at the end of March trains were running to a point three miles out from the new loading station at Engels. During construction some freight has been carried by changing the wagon haul to meet the end of the track. At the end of March 125 carloads had been handled by the railroad, including concentrates and ore going out and machinery and supplies going in.

The high cost of delivering ore and concentrates to the Western Pacific in 1916 was materially increased in the early spring and fall and winter seasons by the employment of animal teams, owing to the mud and melting snow in the cañon road reducing the availability of motors and tractors to a comparatively short period. For several months 250 animals were employed daily. The total cost of hauling to Keddie by team and motor and tractor, including necessary sacking and tramming of concentrates, equaled a sum nearly half as large as the company's investment in the new railroad.

Railway and Power Plant Aiding Development

The construction of the Indian Valley R.R. has already stimulated exploration and development of both gold and copper mines in other parts of the district, and there is immediate probability that the road will be extended into other camps.

To provide for additional electric power necessitated by the large increase in milling capacity, the Great Western Power Co. has constructed a new high-tension line from the Las Plumas plant in Feather River Cañon to the mines, a distance of about 85 miles. Besides providing all the additional power that can be used, the construction of the new electric line parallel with the Western Pacific and the Indian Valley roads will eliminate the serious interruptions caused by snow in the higher elevations of the old electric line. This new line will be completed in May.

The main workings of the property are in the Engels and the Superior mines. These and Rocky Point were diamond-drilled, and the drifts on the Engels and the Superior have disclosed better ore than was indicated by the drills. The approximate total length of tunnels, drifts, crosscuts, raises and shafts in the Engels amounts to 15,000 ft. Tunneling or drifting is carried on at eight levels, crosscutting at five levels, and there are three raises and one shaft. Twelve stops have been excavated on No. 4 and No. 5 levels and the shaft level. The greater portion of the development work in 1916 was done in No. 4 and 6 and the shaft level. The maximum vertical depth of No. 4 from the surface is 350 ft.; the shaft level is 100 ft. below No. 4, and No. 6 is 250 ft. below the shaft level, giving a total maximum vertical depth to No. 6 of approximately 700 ft. In No. 6 level, at a point 1700 ft. from the portal, good milling ore was disclosed, the development in this and in the shaft level showing that the orebody is continuous, follows the contour of the mountain and indicates lengthening at greater depth. The Superior mine was developed only during nine months of the year, the main tunnel being advanced to the 425-ft. point, crosscutting the general strike, and still in ore. Only a small amount of waste was taken out, and the general average of the ore sampled is not less than 2.75% copper. The development is stated by the company to assure 1,000,000 tons of good milling ore in the Superior mine. The drilling at Rocky Point disclosed a large amount of low-grade with some milling ore of sufficient grade to warrant development in the present year. Assessment work on new claims also disclosed good indications of ore, which will be reached by extension of the shaft level for a distance of about one-half mile. Seven new claims were located in 1916, making a present aggregate of 2550 acres of mineral-land holdings. The company has also acquired the Stark ranch, containing about 550 acres of timber and valley lands situated four miles below Lower camp. There is an abundance of timber and water available on the company property.

The total value of the metal production of the Engels Copper Mining Co., in 1916, including the copper, gold and silver content in the concentrate and high-grade shipping ore, amounted to $1,021,565; sundry earnings, $17,951; total earnings, $1,039,516; operating expense, $487,947; net earnings, $551,569. The copper produced in concentrates in the year amounted to 4,312,408 lb.

Notwithstanding the high cost of machinery, materials, supplies and transportation, the company has done a large amount of development in the last three years, increased the mineral and other land holdings, installed a grinding mill and flotation plant, built the railroad and paid approximately $150,000 dividends. The result has in a measure been due to the high price of copper, but chiefly to the development of great orebodies and the practice of economic methods of mining and improved efficiency in the treatment of ores.

The main office of the company is in San Francisco. The mine post office is Engelmine. Henry Engels is president, E. E. Paxton is manager, and John Reinmiller is superintendent.

Bolivian Exports of Lead and Bismuth

Lead exported from Bolvia during 1914 amounted to 1555 metric tons, and in 1915 to 2208 tons, an increase of 653 tons, according to *Commerce Reports*, of the United States Department of Commerce, for Apr. 18, 1917. The high freight rates prevailing on the steamers that traffic along the west coast of South America have hampered this industry, causing the production to be held back, as the prices paid do not more than cover the transportation charges; but there is hope in this country, in view of the reported decrease in the production of Spain and Australia, that the demand will increase for the Bolivian product and that better quotations will enable operators to work under more favorable conditions. Lead is found throughout the highlands of Bolivia in abundant deposits, which generally carry a good percentage of silver to the ton. The following countries purchased Bolivia's lead production in 1915: Great Britain, 1731 tons; United States, 287 tons; and Argentina, 190 tons.

Although it has had no special war application, the production of bismuth has also showed marked improvement. During 1914 Bolivia exported 438 metric tons, and in 1915, 663 tons, which went almost wholly to England, the only exception being a shipment of about 150 lb. to Chile. As this mineral is subject to a monopoly, there is little expectation for increased development. The Bolivian government, in view of the monopoly exercised on this mineral, has placed a much heavier export duty on it than that levied on the other minerals.

Petrography as an Aid to Flotation

By Donald G. Campbell*

SYNOPSIS—Petrography furnishes a simple method for determination of suitability of process and fineness of grinding required for concentration of silver ores by flotation. Comparative tables showing that predictions made upon petrographic data were borne out in practice. Tailing losses shown to have been occasioned by silica coating on facets of sulphides, preventing contact with oil.

Petrography furnishes an exceedingly simple yet powerful method of attacking problems of ore deposition and through the light it sheds on the nature, size and relationships of the mineral particles composing the rock, can help solve many of the problems that confront the metallurgist. Very often a comparatively trifling expenditure of time and expense will answer with accuracy such questions on the suitability of flotation, table concentration and the probable efficiency of separation of various sulphides in complex ores as would otherwise require extended laboratory or large-scale tests to determine. The merits of petrographic investigation need no argument to those dealing with large and many-sided problems of ore deposits, but it is too often ignored or overlooked as a collateral aid in small-scale work and preliminary investigations.

A series of laboratory tests was recently made to determine the suitability for flotation treatment of a refractory silver and gold ore in a Western mine. A stamp mill with vanner concentration had been erected years ago to treat this ore, but with indifferent results, about 50% being the best extraction obtained.

In the course of this work certain variations from expected results were encountered; the distribution of values as determined by screen analysis was inverted from what would have been usually expected, and as a result, while the greater part of the silver values (about 70%) responded readily to flotation when ground to the usual mesh, the remainder was found to be very resistant.

To attack the problem from a new angle, a petrographic study was made of the ore, by which the sequence of mineralization was clearly indicated. This study also furnished definite information on the dissemination and fineness of the individual mineral particles as affecting the degree of fineness necessary to liberate the sulphide mineral from the gangue, and on the probable manner in which the barren gangue will crush as compared with the mineralized portion. The results so predicted were borne out and explained some of the difficulties encountered in the laboratory.

The ore is from an Idaho mine and is fairly typical of a number of Western silver deposits. The vein matter is largely quartz and in hand samples shows partly decomposed feldspar. The valuable mineral occurs mainly as fine dark banded disseminations along fracture planes running through the gangue. Frequent grains of chalcopyrite and pyrite ranging up to 2 or 3 mm. in diameter occur. These are surrounded by the more finely divided "sooty" looking mineralization which contains most of the values and form a "black quartz." This mineral aggregate is composed of various sulphides and traces of antimonides of silver, together with telluride, probably sylvanite and possibly also calaverite, the whole complex being such as was usually grouped together by the old miner of past decades as "sulphurets" and regarded by him with despair as far as successful mill recovery was concerned.

In thin section the material showed a groundmass composed largely of quartz individuals ranging in general from 0.5 to 2 mm. in diameter. Mixed with these were many orthoclase feldspars of about the same size. The latter were usually more or less corroded and decomposed.

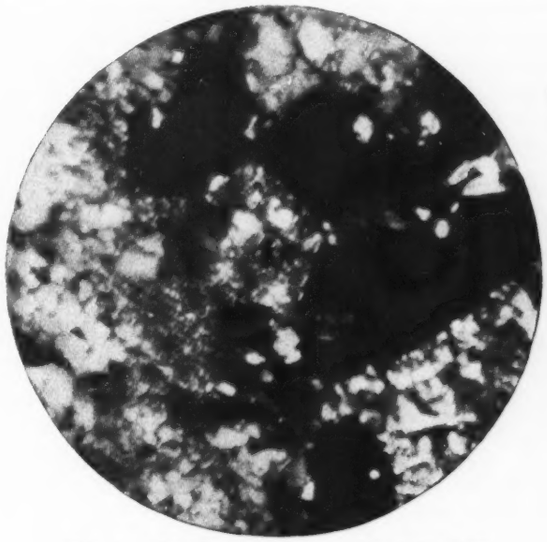


FIG. 1. SMALL SULPHIDE GRAINS AND GANGUE MIXTURE
Magnified 70 diameters crossed nicols

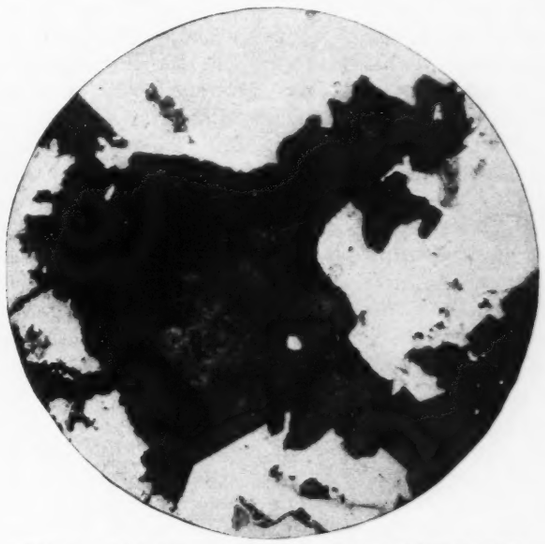


FIG. 2. LARGE SULPHIDE GRAIN OF PYRITE AND ARGENTITE
Magnified 70 diameters, plane polarized light

*Metallurgist, 114 James St., Seattle, Wash.

Minor accounts of accessory and also secondary minerals such as sericite, kaolin and calcite were present. Strain phenomena were shown by these primary minerals, indicating the dynamic agencies which led to the fracturing of the rock. These alterations tend to greatly diminish the original strength of the rock and decrease the difficulty of crushing. Close to the numerous lines of fracture occur the sulphides; and here many of the quartz grains show a zonal growth due to infiltration and deposition of the silica, with which the fractures were subsequently rehealed. It was indicated that the vein was derived from a very acidic aplite dike, with feldspar partly decomposed, greatly fractured by dynamic movement and mineralized in successive stages; and the whole mass was finally silicified and cemented together by the infiltrations introducing a part, at least, of the valuable minerals.

The sulphide minerals were seen to be grains of which a small proportion ranged up to 3 or 4 mm. diameter and lying alongside or in close proximity to the numerous fine fractures which formed the ore-carrying channels, and to consist largely of pyrite and chalcopyrite nuclei, more or less completely surrounded and replaced by argentite. Cutting into both the pyrite and argentite was another mineral, recognized as sylvanite. Minute amounts of other minerals were not identified, but were thought to be mixtures of the above with stephanite and possibly calaverite, among others.

Sulphides and Sulphide Minerals

Beside these larger particles of sulphide, which formed perhaps less than half of the sulphide minerals, were a great number of exceedingly minute grains of sulphide, seldom more than 0.1 mm. in diameter and usually much smaller. These lay either within the tiny channels of ore mineralization or closely adjacent, in a matrix of equally small quartz particles. These quartz grains were tightly interlocked with one another and with the surrounding groundmass of "barren" quartz by a zonal growth or later crystal development. This portion contained almost no alteration material and formed a cement-like mass, almost amorphous and of flinty texture, which would tend to lock up the inclosed sulphide particles very firmly. That this was in fact the case was well brought out by subsequent work in the laboratory.

In the accompanying microphotographs, at 70 diameters' magnification, Fig. 2, taken partly by reflected light, shows a large sulphide grain. The central nucleus of lighter color is pyrite, while the darker growth surrounding it is mostly argentite, the whole in a groundmass of quartz. Note the tendency to crystalline outline shown by the argentite replacement, also the minute ore channels or feeders. These larger particles would be easily recovered by table concentration to form a high-grade product, but with a low extraction—since these large grains represent probably less than 50% of the total sulphide content.

In Fig. 1, the same magnification, are several grains surrounded by many very small particles embedded in the fine, closely interlocked groundmass of quartz.

This material, it is evident, not only requires very fine crushing to free the sulphides, but would also offer much more resistance to crushing than the barren gangue.

A sample of the ore was crushed and a series of tests run under the following conditions: Screen analysis, + 80-mesh, 10%; 80- to 120-mesh, 25%; 120-mesh, 65%; oil, mixtures, 2 to 5 lb. per ton of ore; acid, sulphuric, about 5 lb. per ton of ore; pulp dilution, 1:5; temperature, normal; length of agitation, 20 to 30 min.; weight of ore charge, 500 grams; type of machine, mechanically agitated.

RESULTS OF FLOTATION TESTS

Run No.	Oil	Heads	Tails	Conc. Oz. Ag.	Silver Extraction
6	350*	88.0	24.0	970.0	73%
8	1,580	88.0	27.3	831.0	69%
9 ac. sludge	.....	88.0	24.2	774.2	72%
10 calol, E, 350	.....	88.0	27.5	616.8	69%
16 350, mixture	.....	88.0	24.0	759.0	73%

* Numbers refer to Pensacola oils.

Neutral and alkaline solutions were also employed but with less satisfactory results, the kaolin colloid producing a heavy, dirty froth. Oils ranging from mixtures of heavy pine oil, wood creosote, calol mixtures, as well as gas and coal-tar oil were also tried. A mixture of pine oil, with a small amount of wood creosote, gave perhaps the most consistent results, although the same mixture plus coal-tor or gas-tar oil worked very well. In practice a mixture of from two to four parts of tar oil and one part of pine oil or wood creosote may be found efficient.

Another portion of the ore was then pulverized, sampled carefully and a screen analysis made to determine how the values were divided between the different screen sizes. In such ores it is usually assumed that the valuable content finely disseminated slimes readily and becomes so finely divided that it is impossible to separate by gravity concentration. However, in this case, it is indicated by the petrographe investigation that a considerable portion of the valuable content is firmly locked in the fine-grained silica which fills the fractures through which the mineral itself is distributed, and it was inferred that this combination crushes much less readily than does the granular quartz comprising the greater part of the gangue. This being true, much finer grinding is necessary, to free the valuable mineral so inclosed. That such actually is the case is strikingly confirmed by the analysis which follow. The first screen analysis showed such a complete reversal of the commonly expected distribution of metallic content that it was checked by a second test, which checked the first very closely and confirmed the prediction made as a result of the petrographic work as to the difficulty of releasing the fine metallics.

SCREEN ANALYSIS OF HEADS

Gold, 0.77 oz. per ton; Silver 98.0 oz. per ton

Approximate Screen Aperture	Test No. 1 Mesh	%	Ag, Oz. Prop. per Ton	Ag, Oz. *	Test No. 2 %	Au, Oz. Prop. per Ton	Au, Oz. *	Ag. Oz. Prop. per Ton	Ag, Oz per Ton
0.16 mm.	+80	10.0	197.8	19.8	8.4	1.10	0.09	187.5	15.8
0.14 mm.	80 to 120	25.5	105.2	26.9	29.0	1.00	0.29	116.0	33.7
0.12 mm.	—120	64.5	80.0	51.6	62.6	0.64	0.40	80.0	50.1
		100.0		98.3	100.0		0.78		99.6

* Prorportion of the total value per ton remaining in the respective sizes of product, expressed in ounces per ton; total should check the value obtained in the head assay.

The two screen analyses check closely and show to what a marked extent the coarse particles hold the metallics locked up. That the metallics were not present in coarse concentrates was indicated later by the fact that panning yielded only a negligible percentage of concentrates. Several runs were next made to again check the efficiency of extraction, and in run No. 21 the concentrates were recleaned to a higher grade.

No. Run		Heads	Tailings	Concentrates	Extraction
19	Gold	0.77	0.10	3.20	87%
	Silver	98.00	26.00	673.00	74%
21	Gold	0.77	0.10	6.00	87%
	Silver	98.00	22.00	1,255.00	78%

An analysis was made of the recleaned flotation concentrates from run No. 21 to determine its composition

and to deduce therefrom what grade of concentrates it should be possible to make in practice. The analysis was: Au, 6 oz.; Ag, 1255 oz.; Cu, 3.36%; insol. 47.3% Fe, 19.5%; te, 0.86%; S, 12.9%.

From this it is evident that if it were possible to make concentrates absolutely free from silica, the grade could be almost doubled. But as the silica can probably not be lowered below 20 to 25% without an undue increase in the grade of tailings, it is evident that from this class of ore the probable maximum content will be 9 to 10 oz. of gold and 1800 to 2000 oz. of silver.

In order to ascertain how much of the remaining silver would be amenable to flotation when more finely ground, the tailings remaining from several of the foregoing runs, including Nos. 19 and 21, were reground and again floated, with the following results:

	Orig. Heads	Tailing	Conc.	Extraction	Total Extrac.
Gold	0.77	0.55	1.75	93.5—	87.7
Silver	98.00	13.30	222.50	86.5—	

This is of course a middlings product which in practice would be returned to the circuit for recleaning.

In floating the reground tailings the concentrates formed much more slowly than with the original ore; the extraction was improved and the length of agitation diminished by sulphidizing with a small amount of hydrogen sulphide. The 13.3 oz. of silver still remaining in the tailings is too high to be regarded as very successful work, but it is believed that complete sliming of the tailings will recover a good part of the refractory mineral, and further investigation of the tailings was not considered necessary at the time.

Extended tests being made on silver ores of similar nature have encountered similar conditions, and final success has been attained only by complete sliming of the tailings and the use of sulphidization. Sliming, indeed, had been proved necessary in the treatment of this class of ore by cyanidation, and it was not to be expected that anything less would give the highest extraction, even in flotation.

The necessity of sulphidization is not so obvious. No trace of oxidation of the ore could be seen, and I incline more to the belief that it is due to the fact that even the slimed particles of sulphide are mixed or coated with sufficient silica to overcome their flotation properties, except where the very buoyant influence of fresh sulphidization has been applied.

In a small mill this resistant portion of the tailings would be reground by being returned to the tube-mill circuit with a classifier of the Dorr or drag-belt type, but in a mill of, say, 200 tons daily capacity or greater, I believe that it would be better practice to send it to another small tube mill, to be slimed separately.

A New Silicate of Lead and Zinc

A paper to be presented by P. A. Van Der Meulen at the St. Louis meeting of the American Institute of Mining Engineers, October, 1917, describes a new silicate of lead and zinc, specimens of which were received from W. O. Borcherdt, manager of the works of the Bertha Mineral Co. at Austinville, Va.

The specimens are of dense yellowish slag-like material, containing cavities showing clear needle-like crystals, and representing a product formed by the fumes of zinc oxide and basic lead sulphate from the oxide furnace, attacking the firebrick lining of the flues. The matrix, which is of a greenish-yellow color, is made up chiefly of an amorphous glass carrying numerous crystals, the latter being well-defined, clear and transparent, but colored a light yellow by a little of ferric oxide.

A number of the crystals were carefully separated from the matrix and tested with the blowpipe. They have a fusibility of about 2, yield a globule of lead and a coating of lead oxide before the blowpipe on charcoal, and contain some zinc. Their hardness is 5 to 6. Under the microscope the crystals appear to be made up of a prism, with narrow faces, and a fairly large pinacoid, but unfortunately show no terminal faces. Between crossed nicols they gave parallel extinction in the three planes containing the crystallographic axes and are therefore orthorhombic. The index of refraction is high.

Crystals of the new silicate of lead and zinc obtained from a lead-zinc furnace slag are made up of the prism and the brachypinacoid and have an axial ratio 0.4334:1:?. Chemical analysis shows the composition of the crystals to be represented by the formula $R''_5Si_2O_9$ in which R″ represents lead and zinc in nearly equivalent amounts. They contain small amounts of magnesia, iron oxide and alumina. These crystals can be produced by the slow cooling of a matrix which is more basic than the crystals themselves.

Nevada Consolidated Copper Co.

The report of the Nevada Consolidated Copper Co. for the first quarter of 1917 shows that 18,852,231 lb. of copper was produced—6,279,432 lb. in January, 5,708,214 lb. in February and 6,864,675 lb. in March. During the quarter 940,916 dry tons of Nevada Consolidated ore averaging 1.48% copper was milled, of which 72% came from the pits and 28% from the underground workings of the Ruth mine. In addition, there was 11,530 dry tons of ore from the Consolidated Copper Mines Co. Cost of copper produced, including plant depreciation and all charges except ore extinguishment, and after crediting all miscellaneous earnings, was 11.02c. per lb. Excluding depreciation it was 10.16c. per lb.

Surplus for the quarter was $1,239,018 after payment on Mar. 31 of a regular dividend of 50c. per share and an extra dividend of the same amount. There was set aside $160,446 for plant and equipment depreciation and $56,113 for ore extinguishment, leaving a net credit to earned surplus of $1,022,459.

Price of Zinc to the Government

The letter sent to the zinc producers by the Zinc Committee of the Advisory Commission of the Council of National Defense, asking for offerings of slab zinc (spelter) to supply the present requirements of the Government, states that such requirements are as follows: Grade "A," 6703¾ tons; grade "B," 3440½ tons; grade "C," 225 tons; total, 10,369¼ tons.

The prices of 11½c. for grade "A," 11c. for grade "B," and 9c. for grade "C" (with protection against decline on grade "C") apply only to this specified tonnage.

In view of the small quantity of grade "C," or Prime Western spelter, which is required, the price named cannot have any influence upon the market for metal, nor should it have any influence upon the price of ores in the Joplin district.

Leaching of Low-Grade Copper Ores

By Joseph Irving*

SYNOPSIS—The advantages and commercial feasibility of the leaching of low-grade copper ores in large quantities with or without preliminary treatment, is emphasized. Ores suitable to the process are classified and methods explained by which results are obtainable. The practicability of extracting a satisfactory percentage of any gold and silver in the ore, together with the copper, is demonstrated and actual results are quoted.

It may be admitted that concentration and flotation, like all superlatively good things, have their limits and that with certain copper ores and compounds there are great possibilities for a successful leaching treatment.

It is of course well known that if a roasting treatment (oxidizing, sulphatizing and perhaps chloridizing) is followed by a subsequent leach, almost anything in the way of extraction can be accomplished. Witness, for example, the successful career of the Tharsis Sulphur and Copper Co., which extracts copper, gold and silver by a combination of the Longmaid, Henderson and Claudet wet-recovery methods, and which in a business life of 50 years paid over £10,250,000 in dividends, or a little over $1,000,000 a year during this period. In this instance the residue from the leaching tanks, containing 60% iron and familiarly known at "blue billy" is finally briquetted and smelted to iron.

A somewhat similar method is also successfully applied at Anaconda, where, after roasting, the calcines are treated with brine, leaching out the silver, which is later precipitated on the copper as the copper is precipitated on the iron. These companies have demonstrated the commercial applicability of a combined roasting, chloridizing and leaching treatment on material differing as greatly as do the sulphide ores of Spain from the siliceous mill tailings of Anaconda.

Two Classes of Ore Amenable to Treatment . .

Two classes of ores way be considered: Those that contain sufficient pyrites in themselves and can be roasted with or without salt, and the resulting gases collected and converted into acid, with which the metals can be successfully leached from the roasted material; and ores that may have a highly siliceous gangue with the addition of the necessary amount of iron pyrites (which in itself may carry copper, etc.) and salt, can be roasted in from six to twelve hours, and the copper, gold and silver leached out by means of water and dilute acid, the latter being obtained as a byproduct. This method can be adopted with low-grade (about 2% copper) ores carrying appreciable amounts of gold and silver and having a highly siliceous gangue, 60%-70% silica and from 10%-12% alumina. Ores most amenable to this treatment of roasting, chloridizing, etc., are those which of themselves contain sufficient sulphur. Roasting to oxides or sulphates or chloridizing always means a heavier plant installation for furnaces, condensing towers, etc., but for operation there is no need to purchase acid, as the necessary solvent is always to hand in quantity.

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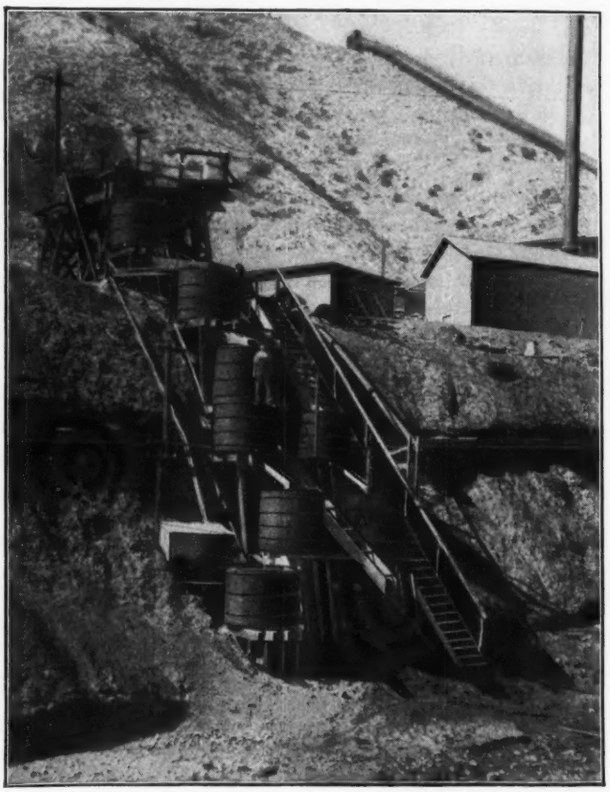
Attention may be directed to certain ores which do not need a preliminary roast, but which in the raw state are amenable to a quick direct leaching treatment, with sulphuric acid as the principal agent. One commendable feature in a direct-leaching scheme is its simplicity and cheapness, the raw ore going direct from the crushing plant to the leaching tanks and the liquor from there to the recovery tanks and launders.

An immense low-grade deposit belonging to the New Cornelia Copper Co. at Ajo, Ariz., promises to become a striking and successful example of what can be done by direct leaching on a large scale. There is also a considerable amount of oxidized material at Bingham, Utah, which the Utah Copper Co. is going to treat by leaching, after the style of the Ajo and Chuquicamata plants, in large tanks capable of holding about 4000 tons each. The recovery at the Utah Copper Co.'s plant will probably be precipitation on iron, at least to begin with. This should turn out to be one of the cheapest and most successful of the big leaching propositions, as it will be possible to recover gold and silver in the ore as well as copper.



EXPERIMENTAL LEACHING PLANT AT COPPER QUEEN

The contention has been advanced from time to time that gold and silver cannot be extracted at the same time as the copper from raw ore by a direct leaching treatment without a preliminary roast. Recent practice, however, demonstrates that gold and silver when present in appreciable quantities can be recovered at the same time as the copper by a direct leaching method, that is without any preliminary roast.[1]

[1]U. S. Patent, 1,048,541, Dec. 31, 1912.

In treating an ore from Bingham, the following results were obtained:

	Copper, %	Gold, Oz. per Ton	Silver, Oz. per Ton
Heads	1.68	0.04	0.54
Tails	0.13	0.01	0.09
Product (precipitate)	87.0	0.16	14.16

A more refractory ore from a tailings dump at Tintic gave:

	Copper, %	Gold, Oz. per Ton	Silver, Oz. per Ton
Heads	0.91	0.13	8.40
Tails	0.20	0.08	2.50
Product (precipitate)	40.36	0.35	124.65

This goes to prove that at least a fair proportion of gold and silver can be recovered with the copper by direct hydrometallurgical treatment. It was long contended that the spent liquors from that part of a plant where iron is used as the recovery agent are worthless and cannot be used again. However, it has been clearly shown that these spent liquors are valuable and can be used to great advantage in ordinary tank-leaching work, on surface heaps or for underground leaching, provided due care is taken. Apart from the chemical benefit derived from the re-use of these liquors, the saving of water in some parts of the West is a consideration not to be despised. Where a leaching treatment is followed by a combined electrolytic and iron precipitation recovery, or a total recovery on iron, the actual waste-liquor supply would be intermittent, due to fouling.

In the case of a highly aluminous oxide of the following composition: Copper, 3.31%; iron, 28.65%; silica, 24.50%; alumina, 11.82%; lime, 2.25%, it has long been considered impossible to leach this economically. It is also difficult to mill. Work carried on at Bisbee, Ariz., for the Copper Queen has demonstrated that this class of material can be successfully and economically handled if given a preliminary treatment with partly regenerated spent liquors from a cementation plant, followed by a sulphuric-acid leach. By treating first with ferrous and ferric solutions (partly regenerated spent liquors) it is possible to overcome these troubles, which might cause a high consumption of sulphuric acid. I have tested this method on ores carrying 20% lime, and no unusual amount of acid was consumed during treatment.

It might be well to consider also those ores that lend themselves more readily to a milling treatment, but at the same time may carry a fair percentage of their copper in oxidized form either as a sulphate or carbonate. If these ores were crushed in a solution containing ferrous and ferric salts and the whole pulp passed through classifiers, the slimes and copper in solution could be diverted to thickening tanks or replacers from which the copper liquor could be led to precipitation tanks and the slimes if necessary passed over slime tables or to flotation tanks. The sands from the classifier containing the unattacked sulphides and free from gelatinous or slimy gangue would pass on to tables, where a good separation would be assured. This method would give high returns on mixed oxidized and sulphide ores, and but little would be added to the ordinary milling cost. The process would be continuous throughout and is better than concentration, as a first step, with subsequent leaching of tailing.

The question arises in the case of a low-grade copper proposition of 1% copper content, partly oxidized and partly sulphide, as to whether it is really necessary to go to the trouble and expense of building roasters, crusher plants, leaching vats, etc., with the thoroughness that a good leaching plant calls for. Why not leach on a prepared floor, which might be of concrete, but could just as well be made of some cheaper material? It is only a question of piling carefully in order to insure proper saturation, percolation and oxidation. Stone flues or culverts may be made from the larger pieces of ore which it is intended to treat, and perhaps some chimneys of the same material, dependent on the height of the heap. These will help toward insuring proper oxidation. The same culverts will act as drains and can be laid out so that all liquors percolating through the heap will drain to a common settling tank.

Much experimental work on this line has been carried out by the Copper Queen and the Burro Mountain, and from the results obtained it appears to be a cheap way of making copper from material that has long been regarded as waste. Tests in 10-ton lots showed an extraction of 28% in five days. Other ores showed an extraction varying from 45% to 50% in four months. A recovery of 80% would simply mean time, perhaps two years.

The possible results obtainable in one year by treating a 100,000-ton heap of ore containing 1% copper may be

LEACHING HEAP AT COPPER QUEEN EXPERIMENTAL PLANT

estimated as follows: 400 gal. liquor per minute, equal to 576,000 gal. per day, containing 50 grains of copper per gallon would mean 4110 lb. copper per day. In one year this would amount to 1,500,000 lb., which at 15c. (a price which seems ridiculously low at present) is equal to a gross return of $225,000. Local treatment costs would be about 6c. per lb., to which refining and marketing charges must be added. There is no reason, however, why a heap should be restricted to 100,000 tons. In some cases it might be 1,000,000 tons. To build a heap of 1,000,000 tons would require a floor space 2000 ft. by 500 ft.

A cementation plant built entirely of wooden tanks and launders, with the necessary false bottoms to support the iron, and at the same time allowing a space from 8 in. to 12 in. between floor of tank or launder and sills of false bottom, would permit of the recovery of copper precipitate without the necessity of moving the iron every time a cleanup was in progress.

Iron is the most satisfactory recovery agent in general use, and pig iron is one of the best classes of iron to use when it can be obtained cheaply. Old rails, pipe, water jackets, mine cars—in fact anything in the shape of iron-scrap—will do. Tin cans are suitable where they can be bought cheaply though they do not seem to make the best class of precipitate. All iron to be effective should be clean and free from paint, grease or any coating.

The Liberty Loan, Its Economic Status and Effects*

By F. A. Vanderlip†

SYNOPSIS—The loan projected is discussed in relation to the country and its wealth. The possible effects of the loan, too, are far reaching, and may have a great effect upon the world's future.

We are a good deal dazed by the size of this loan; the authorization of a $7,000,000,000 credit is something of a shock to the country. Not many people have thought in billions of dollars. All the stocks listed on the Stock Exchange are less than twice that amount; all the stock of all the railroad companies in the country aggregate only $8,700,000,000; all the bonds of all the railroads in the country are little more than that figure. It is a huge total. And this amount must be raised this year. Don't think we are going to stop with $2,000,000,000. We are going to raise more. There will be other loans following this about as soon as this is out of the way, but while it is almost incomprehensively large, so is the country, so are our resources. There are 15¾ millions of depositors in the National banks alone in the United States. I should think it safe to say that there should be ten million subscribers to this loan if the people wake up to the need for the loan and the opportunity it offers. The last loan of Germany with her 65,000,000 inhabitants had nearly 6,000,000 subscribers. Surely we ought to have 10,000,000 subscribers in America if we would only wake up to it. The National Bank deposits have increased in 10 months $2,000,000,000—enough to take this part of the issue that is now being offered. The resources of the banks in America total $35,000,000,000. So you see, huge as this loan is—almost inconceivably large—it still is not so large when you measure it by some of the totals of the country. Our wealth is about $220,000,000,000. If the people subscribed to 5% of their wealth, they would oversubscribe this issue about six times. Back in the Civil War days with bank resources $\frac{1}{20}$ of what they are now, we raised $3,000,000,000. So you see we are not facing an impossible proposition, but we are confronted by a serious proposition. I feel that people are not altogether awake to the seriousness of this war; not altogether comprehending that we are in war, that we are in a very serious war—war that might even come to our own shores. It is easy to think that Germany is 3000 miles away, surrounded by the greatest armies that were ever assembled; that the war is likely to be over before we can get any men into it; that we are like a manufacturer or merchant who is getting his customers to keep on buying at rather exorbitant prices, and that we are doing a good thing in loaning to the Allies, but that we are not in a very serious situation. As I conceive, it is much more serious than that.

Now just let us take one or two contingencies that are perfectly possible. We have had a revolution in Russia. No man in America or Russia can tell what the future of that situation is. It is surely conceivable that Russia might make a separate peace. I do not believe she will, but it is conceivable. What would happen then? It is said that there are a million and a half prisoners in Russia. Suppose all the forces of the Central Powers on the eastern border might be withdrawn; suppose their forces were augmented by a million and a half returned prisoners; suppose Russia's food stores were opened for Germany, and all that happening very promptly, which is a conceivable thing. In that event could the armies of England and France on the western border withstand the onslaught? Is it not conceivable that if some solution is not found for the submarine menace, that England may be brought to the point of starvation? No matter what her wealth may be, starving men could not fight. I tell you it is within the possibilities that we may be raising not a Liberty Loan to pay for a war we hope successfully to wage, but a loan to pay the cost of a war Germany has been waging on civilization. This is no wild picture. I certainly do not believe it is within the future of events but there is possibility enough in it to cause us to wake up as a nation, to make us recognize that we are in a great and uncertain war, and that we must support the military movement which this Government has got to make.

The Richness of America

We are a tremendously rich country. We must raise $2,000,000,000. Our wealth, as I have said, is about $220,000,000,000. Where is this wealth? It is in farms and railroads and factories and instruments of production. But you cannot subscribe a railroad to a loan; you can't subscribe a factory. We must have fresh capital for this loan. Now remember that a war is the current effort of a nation; nothing that has been done in the past can fight it. It has got to be fought out of the current savings of the nation; all the savings of the past have been invested. The savings are now invested in fixed forms of capital; they are in the railroads, and farms and factories, and the money that is going to be raised must come from the savings of the future, not the savings of the past. You may say, "I can purchase a bond with some money I have in the bank." Yes, you can, but this money you have in the bank is at work today; it is not idle. If you draw it out, somebody's loan must be called. This fund must be raised out of the savings from now on. The wealth you have accumlated is not in a liquid form. The past savings are invested and we want $2,000,000,000 right away—not some time in the future. These $2,000,000,000 will be spent before they are paid in, under the terms of the offer. You are going to raise this money by a creation of new credit now. You can get $50 subscriptions. Get every one you can. Get the whole ten million people to subscribe, but after you have all the success you can hope for with the $50 and $100 bonds, you will not have a very large total, measured by a two billion dollar loan. I am not in any measure discouraging these small subscriptions but the loan is going to be made up of much larger subscriptions. The men who will make

*Condensation of an address before a meeting of the Fifth Group, New York Bankers' Association, Albany, N. Y., May, 1917.

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these larger subscriptions are not going to make them from idle capital but from money which they will borrow.

Now what are the motives to lead men to subscribe to the Government bonds? One is profit. The sense that it is a sound investment returning a good rate of interest. The other is patriotism. Let us take up the first set of reasons. Is this an attractive investment or are you facing calls to make financial sacrifices? I don't believe it is a sacrifice. You are being offered a bond for security which is beyond question the finest piece of paper in the world. The rate—3½%—looks low, but there are perquisites attached to that bond. Its income is free from taxation. You know what the minimum return is that goes into your pocket. You don't know what the maximum will be because the rate may be more. If this war goes on, and it looks as if it may for a good while, the chances are good that it will be more. You are not going to be penalized by being a subscriber to the first loan, that is certain. Whenever a subsequent loan comes out at a higher rate of interest, you are going to be in just as good condition as the tardy subscribers.

Prospective Value of Bonds

Now does anybody doubt that when the War is over and the pressure is off the market for Government loans there will be a rise in the value of Government bonds? I don't believe anybody would doubt that. Now remember the bonds you buy now bearing 3½% have a practical guarantee of parity, that is to say, if events go so that the Government cannot raise money at 3½%, your bonds will be convertible into the higher rate, and the minute the war is over, your bond at par will command a premium. I cannot think of a situation that will not find these bonds bearing a premium on their issue price after the War is over.

Aside from the idea of profit or sacrifice, there are much nobler reasons why ten million people should subscribe to these bonds, and they are an attractive investment. Our belief in democracy, our belief in this Government, the foundations of our belief in freedom lie back of the motives that ought to move ten million to subscribe to this issue. Now we have got to be waked up as a nation to the fact that we are in war. I heard a newspaper editor say the other night that he had secret information that we were in war, but he had not been able to get it over to his readers yet. And there is a good deal of truth in that. We have not as yet recognized what an unsuccessful prosecution of war would mean. We want to wake up to some of the psychological effects of a very successful subscription to this issue. It would be pretty discouraging to Prussianism if this loan is subscribed twice over. It will be very encouraging to those men who are fighting under the flags of France and Great Britain on the Western front. It will unite this nation to a degree, I believe, to see that this issue is a tremendous success; that the whole people are back of the President, back of his declaration for liberty. The patriotic reasons seem to me so overwhelming that we hardly ought to think of that other side—whether this is an attractive investment—although it is an attractive investment. It is going to mean something besides patriotism in America; it is going to mean a new element in American life. It is going to mean an element of economy. We have got to have it just as certainly as we have got to have this expansion of credit to make this loan a success, because the banks must be paid from future income and there must be economy to permit that being done. We cannot give the Government seven billion dollars or any other number of billion dollars of purchasing power and expect to have just as much purchasing power ourselves. That would be a miracle of loaves and fishes that we cannot work out. We have got to economize. We have got to see that what we spend, we spend for necessities. You say "Yes, but what is going to become of business, it cannot go on as usual." We do not want business as usual. Our business is war. It is going to take the whole strength of this nation and it is going to discommode some people, probably discommode a good many people. You cannot have war without worries. You have got to remember that we cannot go on making unnecessary things, luxurious things, and make seven billion dollars worth of other things for war. Now you say, "Yes, but you have disorganized industry. You will make it necessary for producers to throw their employees out of work." Let me tell you there is going to be all the work that is possible to do for all the men and all the women that we have got to do it. There are two jobs waiting for every man there is to take hold, so we have got to have that kind of economy, the kind of economy that will make you weigh whether what you buy is absolutely necessary, for if you do buy something that is not necessary, you are competing for labor with the Government, which is engaged on works that are a national necessity. I think that is the test men must make of their purchases during this war. Are they competing with the Government for work that is unnecessary?

The Objections to the Loan

Now I would like briefly to consider some of the objections to this loan—some that I have heard—and I hope later to hear some more and see whether we can sit down together and reason out answers for them. I say that men have got to borrow to invest. They have got to invest more capital than they have in immediate reach. There will be objection to that surely. The rich man or any man used to making investments may regard it as a very poor policy to go in debt. He has occupied the position of creditor, not debtor. But I believe when he sees the economics of the whole situation, when he sees the demands that are upon us, when he sees the resources that are available to meet that demand, he will see that borrowing is what he must do. The richer he is, the greater should be his borrowing.

I have heard some men say, "Well, I will wait, I will not invest in this loan now, the Government will need money on the third and fourth loan more than now." The rule of conduct that any man adopts may be measured by the results that would follow if all men adopted it. If you do not subscribe to the Liberty Loan now, there may be an indemnity loan later and you will subscribe to that. You had better all subscribe to this one and not have the Government lacking in the support that means military success.

You will find men who will say, "We will invest only our available cash; we won't borrow." But I beg of you to see this as I do and ask those men to borrow

and invest all they hope to accumulate in the months to come.

You will find individuals who will tell you it is the Banks' affair. It isn't. It is less the Banks' affair than anybody's else in respect to the original subscriptions. It is not the function of a bank to tie up its deposits in a fifteen or thirty year investment, but it is the function of a bank to loan to an individual or corporation on a ninety day note, secured by the bond. That is the banks' function. Let the Banks aid the men who subscribe.

Bankers have got to increase credits. You cannot put the farm or the factory in; you have to subscribe current bank credit and to do that we have got to have inflation, which is expansion. Do you fear inflation? I am not afraid of inflation that has its basis in Government bonds. There is back through this chain of operations a perfect check on it. The Federal Reserve banks can loan and loan but there is a stop there. They can not loan after they get to a certain point in reference to their gold reserve. They are perfectly safe in inflating credit since the basis is Government bonds, and there is an ample basis of gold in the Federal Reserve banks. Let us not get alarmed. Let us take a little cheer that we are going to have this expansion and great growth in loans. I would almost be brave enough to say that we are going to have pretty easy money after this first loan. I think that it is improbable that we will have high money as a result of something over two billion dollars increase in deposits, which will be the effect of the operation according to my reasoning.

I think I can foresee some changes that we are going to get. It isn't all on the debit side as a result of this war. If we are going to loan three billion dollars to the Allies don't you think our international trade conditions are going to be improved by that? I do. Very greatly increased. And all the energies spent on the war are not going to be wasted. There will be new processes evolved, there will be new lessons learned in speeding up industry that will prove of great value. I remember that Huxley said that all of the costs of the Franco-Prussian War to France and the whole indemnity was paid up by the work of Louis Pasteur and its effect on the industries and life of France.

Now as to thrift. If we can get a considerable number of these ten million people that I want to subscribe to contract the habit of thrift, something of this habit that has made this marvelous effort of France possible, we will have made great progress. But the success of this loan, the successful prosecution of the War, the making of the sacrifice and the effort will bring to us a victory which will be greater than anything we can get from Germany—a moral victory within ourselves. We have grown luxurious and careless. We have needed this great moral awakening. I believe this meeting is just one of endless meetings that will make men soberly think of the moral gain that is to come out of this great war.

Arizona Tungsten Monopoly?

PHOENIX CORRESPONDENCE

The Arizona State Council of Defense has passed the following resolution: "Whereas it is reported that the Primos Chemical Co. is a concern operating for the benefit of enemy interests and whereas it is reported that the same company has been tying up under long-term leases considerable property containing tungsten, molybdenum, vanadium and other steel-improving metals, and whereas such practice is opposed to our national-preparedness programme and lessens our available resources, therefore be it resolved that the State Council of Defense recommends an investigation of the activities of the Primos Chemical Co. and steps to prevent the continuance or extension of this practice by this or any other company." Local mining men, however, doubt that the Primos corporation has another end in view than that of controlling the market, and assert that at least half of its metals go to the Bethlehem Steel Co. A California company in the same line is reported to have been about as active in securing control of potential tungsten- and molybdenum-producing mines in the Southwest. Control of the product is asserted to have become about complete, with only a few properties near Wickenburg still open. It is probable that the council will suggest to the National defense organization that all restrictive leases and bonds be held as contrary to public policy and that active operation of all such mines be ordered for war-time needs. The state council's committee on scientific research has recommended that the State Bureau of Mines be requested to undertake a complete compilation of the mineral resources of the state and their capability of production, such data to be supplied to the Government with particular reference to fertilizing minerals, tungsten, molybdenum and vanadium.

The treasurer of the Primos company, Gideon Boericke, having been informed of the state council's resolution by Capt. John D. Burgess, of Tucson, telegraphed him on May 12 as follows:

Telegram received. Thanks for your information. Would state that the owners of the Dragoon deposit have been trying for years to sell the property. Primos Chemical Co. is in no way interested in any property in Arizona. Primos Chemical Co., together with all individuals or interests in any way connected with company, do not own or control, directly or indirectly, more than 15 to 20% of tungsten ore produced or consumed in this country, nor more than the above percentage of the possible production in this country. Above statement probably holds good for all other products which we manufacture with the possible exception of vanadium, in which product our chief competition comes from cheap Peruvian ores and our possible production might be 25 to 33% of total produced in this country. About a year ago Primos offered its entire energies, knowledge and resources to our government in event of war with any first-class power. Kindly bring these facts to the attention of Arizona defense council.

[As a matter of fact, it should be stated that the Atolia Mining Co., of San Francisco, Calif., and not the Primos company, is the largest tungsten producer in the United States. The Atolia production or that which it markets probably amounts to a little more than 50% of the domestic output.—Editor.]

The Corporation of Technology and Industries

The facilities of the great laboratories of the Massachusetts Institute of Technology, offered to the United States Government for research work, are also to be made available to industrial concerns. The United States Smelting, Refining and Mining Co. has, through W. G. Sharp, president, entered into an agreement whereby the company is to avail itself of the laboratory facilities, commencing in April. The Corporation of Technology has named Henry M. Schleicher as research associate in charge of the work, with H. O. Hofman in charge of Mining and Metallurgy.

Company Reports

Hollinger Consolidated Gold Mines, Ltd.

Inasmuch as the Hollinger Consolidated Gold Mines, Ltd., Porcupine, Ont., is really the successor of Hollinger Gold Mines, Ltd., the annual report for 1916 is called the sixth annual report in order to maintain an unbroken record.

Unsatisfactory labor conditions and increased cost of supplies increased the cost of operations until they were at the end of 1916 practically 50c. per ton above normal, which means a reduction in profits of from $900 to $1000 per day. Scarcity of labor prevented the aggressive development of higher grade orebodies and made it necessary to mine and mill the ore most easily available. Annoying delays in the deliveries of machinery held back the completion of the extension of the mill for nearly five months, thus causing a serious loss in tonnage of ore treated. The mill building has been completed and the machinery is being installed.

During the year the ore hoisted from the mine amounted to 604,062 tons, of an average value of $8.84 per ton, worth approximately $5,342,000, notwithstanding which the ore reserves show a greater value than a year before.

Profits for the year amounted to $3,006,409, of which $180,000 represents the premium of $1.50 per share on the sale of 120,000 treasury shares. Dividends amounting to $3,126,000 were paid, thus causing a deficit from operations of $119,590, to which must be added $150,000 written off for plant depreciation. The report continues: "The deficit is largely technical and so small in comparison with our total operations that it has no real significance and will be readily made up once normal economic conditions are restored."

In view of the unfavorableness of general conditions prevailing at the end of the year, it is considered to be for the best interests of the shareholders to conserve the company's interest and properties rather than to continue to disburse the amount of dividends which have been distributed every four weeks, and it is therefore contemplated to either make less frequent distributions of the present 1% dividend or to reduce the rate by one-half.

The average number of men employed during the year was 1056, and during the year the wages paid amounted to $1,223,433, in addition to which bonuses for loyal service were paid amounting to $36,794. The directors of the Canadian Mining and Finance Company, Ltd., large holders of the Hollinger stock, have also made a substantial stock distribution among about 40 members of the staff besides the distribution which they have made to employees serving in the army.

Total working costs in 1916 were $4.03 per ton, as against $3.98 in 1915.

South Hecla Mining Co.

A report of operation and business of the South Hecla Mining Co., Utah, for the year 1916 shows that there was mined and marketed on company account 15,923,050 lb. of dry crude ore, which had a gross value of $166,915. The total metal content of this ore was 267.140 oz. of gold, 164,619 oz. of silver, 1,236,357 lb. of lead, 55,366 lb. of copper, 738,473 lb. of zinc and 782,059 lb. of iron. There was mined and marketed on lessees' account 2,195,035 lb. of dry crude ore, which had a gross value of $21,989. The total metal content was 33.802 oz. of gold, 16,493 oz. of silver, 218,015 lb. of lead, 5361 lb. of copper, 157,854 lb. of zinc and 47,089 lb. of iron.

The total net stoping profits for the year on company account and lessees' account was $42,222.

During the year developments underground greatly increased the indicated extent of the orebody both vertically and horizontally, "the ore being followed horizontally 800 ft. in a westerly direction and proven for a vertical depth of 430 ft. from the surface." The report states that ore shipments were greatly retarded during March, April and May on account of bad roads, and in July, August and September on account of the congested condition of local smelting companies, and during November and December owing again to bad roads. The company owns over 500 acres of mineral land, of which less than 10% has been explored. The property is well equipped with necessary buildings and machinery for operation. The contemplated exploration work for 1917 is expected to increase greatly the indicated tonnage of the milling-grade orebodies opened in this property. During the year there was distributed to stockholders $39,437 in dividends. The report concludes: "In general, the future outlook is indeed very promising."

Vindicator Consolidated Gold Mining Co.

The Vindicator Consolidated Gold Mining Co., operating in the Cripple Creek district of Colorado, reports for the year ended Dec. 31, 1916, that 319,197 tons of crude ore was mined, which gave 119,130 tons of shipping ore of an average value of $19.27 per ton, making a gross value of $1,324,873, and net after paying freight and treatment charges $1,001,709. In addition lessees shipped 61,152 tons of ore from which the company received $226,231. Operating profits for the year were $564,813 and total earnings, less interest, $628,226.

Ore reserves at the end of the year are estimated at 412,796 tons in the mine, of which 100,740 tons is broken in the stopes and 312,056 is blocked out but unbroken. This is 36,261 tons more than at the close of 1915. In addition there is about 2,000,000 tons of dumps on the property, from which it is estimated that a profit of 50 to 75c. per ton can be made by the flotation process.

Total development work for the year amounted to 22,029 ft., of which 8294 ft. was driven by lessees. Total development to date is 245,106 ft., this figure including development work done on the Golden Cycle shaft since its purchase and excluding that done by its former owners. About 25% of the known mineralized area on the 20th Golden Cycle level and 19th Vindicator level has been prospected without finding pay ore, but there seems to be no geological reason why pay oreshoots should not be found on these horizons.

Data concerning the washing and concentrating mill are incomplete. There is no statement as to the concentrates recovered, although 127,947 tons of $1.68 ore was milled at a cost of 17.4c. per ton.

Dividends paid in 1916 amounted to $270,000, and to date, $3,532,500 on a capitalization of $1,500,000. Current assets as of Dec. 31, 1916, amounted to $217,044 and current liabilities to $56,012.

The Coniagas Mines, Ltd

The annual report for the fiscal year ended Oct. 31, 1916, of the Coniagas Mines, Ltd., St. Catharines, Ont., states that the years' operations were fairly satisfactory. The silver mined and shipped during the fiscal year amounted to a little over 1,750,000 oz., compared with about 2,000,000 oz. during the previous year. The average price received for the sale of silver was 63.11c. per oz. in 1916, as compared with 49.25c. per oz. in 1915. The great demand for high-speed tool steels for munitions manufacture made a market for cobalt metal which made up for the dullness in cobalt oxide for ceramic purposes, which decreased on account of the war. The operations at the mine and smeltery were carried on more vigorously than during the previous year. Including the customs ore purchased by the reduction company, the combined output of the mine and smeltery exceeded $4,500,000. The estimate of ore reserves on Oct. 31, 1916, represented a total of 6,000,000 oz. of silver, in addition to which there was a little less than 1,000,000 oz. of silver in the sand and slime tailings on the property, which it is expected can be recovered profitably by the flotation process.

During the year options were taken on two gold prospects in the Porcupine district and considerable exploration work was done.

Two dividends of $200,000 each were paid, making a total return to the shareholders since incorporation in 1906 of $8,440,000.

An interesting feature of the company's report is the honor roll, covering nearly two pages, on which appear the names of the employees who are in the service of their various countries in the great war in Europe.

The Pittsburg-Idaho Co., Ltd., of Gilmore, Idaho, reports that during 1916 $44,928 was distributed to stockholders in dividends from a net operating profit of $159,934.

Consolidated Arizona Smelting Co. reports that during the first quarter of 1917, 37,107 tons of ore was smelted, producing 4,780,000 lb. Cu, 1758.8 oz. Au and 48,251 oz. Ag, with a net profit of $263,713, which is an increase of $103,235 over the corresponding period for 1916.

Chief Consolidated Mining Co., of Arizona, in its annual report for 1916, shows that 83,606 tons of ore was shipped during the year, resulting in a net profit of $630,830, from which four dividends, amounting to $176,491, were paid to the holders of 249,185 shares of stock issued.

The Consolidated Mining and Smelting Co. of Canada, Ltd., in its annual report for 1916 shows a net profit from operations of $996,496, after writing off $278,386 for depreciation and charging profit and loss with $598,745 expended in development. Dividends amounting to $776,337 were paid during the year.

Chief Consolidated Mining Co.'s operations during the first three months of 1917, have consisted of the extraction of 19,566 tons of ore containing 2960 oz. Au, 406,199 oz. Ag, 4,232,335 lb. Pb and 93,260 lb. Zn. Average value per ton, $36.99; cost, $13.91, leaving a net profit of $23.08 per ton, a total profit of $202,435.

Winona Copper Co., of Winona, Mich., shows in its annual report, that during 1916 there was treated 161,828 tons of ore, which yielded 2,167,255 lb. refined copper, or 13.39 lb. per ton, which was sold at the average rate of 28.03c. per lb. No dividends were paid, $106,720 having been added to the assets of the company.

Bannock Gold Mining Co.'s annual report for 1916 contains an estimate of ore reserves showing 130,700 tons "actual" at $7.34 and 106,000 tons "probable" at $7.55. Cost of mining and milling, it is anticipated, will be $2.50 per ton, leaving a net value of $1,167,750. Residue loss from treatment does not seem to have been accounted for. Operations are expected to begin before Apr. 1.

Salt Lake Mining Co.'s annual report for 1916 shows that production began in May, and although complete smeltery returns are not available, it is estimated that the yield of refined copper for the year will be 285,600 lb. The income for the year, including the sale of 10,000 shares at $7.75, amounted to $158,972, to which may be added assets as at Dec. 31, 1915, amounting to $16,958.11, totaling $175,930.11. Expenses for the year amounted to $173,717.94, leaving a balance of "quick" assets of $2212.17.

American Zinc, Lead and Smelting Co. and its subsidiary companies, including the Granby Mining and Smelting Co., show in the report for 1916 a total profit of $9,307,967. Surplus carried over from 1915 amounted to $5,855,641.09. Dividends of cash and preferred stock amounting to $10,259,292 were paid, $4,904,316 being carried to surplus. During the year additional properties were secured, included in which were the assets of the Granby Mining and Smelting Co., consisting in part of approximately 30,000 acres of mineral lands in the Joplin district, 10,000 acres of coal lands in Illinois, a coal zinc smeltery at Roselake, East St. Louis, Mo., and a lead smeltery at Granby, Mo.

Tonopah Belmont Development Co., of Nevada, reports that for the fiscal year ended Feb. 28, 1917, the gross value of production from all properties amounted to $2,531,737; losses in treatment, $165,746; net values realized, $2,365,991; operating expenses, $1,112,350.; net earnings, mine and Tonopah mill, $1,253,642; net earnings other plants, $37,065; total net earnings from operations $1,290,705; other income, $145,768; gross income $1,436,473; administration, exploration and taxes, $191,373; net income, $1,245,100. A total of 145,024 dry tons of ore was mined containing an average content of $17.45 per ton, from which $16.31 was recovered at a total cost of $7.67. A recovery of 27,831 oz. Au and 2,629,465 oz. Ag was effected. The average cost of mining was $4.179 per ton; milling, $2,897 per ton; miscellaneous, $0.762; with a credit of $0.084 from miscellaneous earnings. Dividends amounting to $750,017.81 were paid to stockholders.

Eagle and Blue Bell Mining Co.'s report for 1916 indicates gross earnings at the company's properties in the form of net receipts from ore shipments plus ground rents, etc., at $323,994.70. Operating expenses absorbed $120,528.33, mine development $39,841.09, and general expense $8848.79. Dividends paid during the year amounted to $89,314.60.

Franklin Mining Co., of Michigan, treated, during the year 1916, 267,286 tons of rock for a total product of 3,116,566 lb. copper, which was sold at an average of 25.432c. per lb. Undelivered copper to the amount of 338,702 lb. has been sold at 27c. per lb. No dividends were paid, the company having paid off notes to the amount of $155,000 and carried forward to 1917 a surplus of $192,094.

Broken Hill South Silver Mining Co., of Broken Hill, N. S. W., Australia, reports that for the half-year ended Dec. 31, 1916, dividends amounting to £120,000 were paid, as well as £20,000 set aside for probable taxation, £16,511 written off to plant account and a balance of £149,000 carried forward to 1917. A total of 157,059 tons of ore was mined, containing an average of 14% Pb, 13.8% Zn, and 6.7 oz. Ag per ton, from which 27,650 tons of concentrates was recovered carrying 60.6% Pb, 8.9% Zn and 21.3 oz. Ag per ton. Ore reserves, with no allowances made for "probable ore," are estimated at 3,500,000 tons.

Federal Mining and Smelting Co., in the president's report for 1916, shows that dividends of $4.25 per share, amounting to $509,409, were paid on the 119,861 preferred shares outstanding. The mines of the company are the Wardner, Morning and Mace, classified as "profitable mines"—and which contributed profits amounting to $1,279,535; the Iron Mountain and Frisco, which were unprofitable; and the North Star and Triumph groups, acquired during the year and undergoing development and equipment. Included in the company's assets are 28,000 shares of Bunker Hill & Sullivan stock.

Silver King Consolidated Mining Co., of Utah, in its annual report for the period ended Jan. 31, 1917, states that the gross receipts for ores sold amounted to $500,499, from stock sales $150,000, and from interest and discounts and miscellaneous $25,747, a total of $776,246. Total expenditures were $437,976, including property purchase amounting to $71,897 and accounts payable paid to the amount of $10,887, and such items as assessment work, titles and patents, and boarding house. Dividends amounting to $294,561 were paid to the holders of 688,581 shares of stock. The mines produced 10,082 tons of ore which averaged $49.57 per ton. A cable tram 10,200 ft. in length and having a capacity of 20 tons per hour was completed and put into successful operation.

Copper Range Co., Michigan—Annual report for 1916 covers the operations of the Baltic Mining Co., the Champion Copper Co., the Trimountain Mining Co., the Copper Range Railroad Co. and the Atlantic Mining Co. A total of 54,747,498 lb. of copper was produced, realizing, with accrued interest, $13,910,036. Production and marketing expenses amounted to $4,771,399, and taxes, $327,195. The dividends paid during the year amounted to $3,941,648, and the sum of $2,136,542 was added to working capital as balance of income for 1916. The Copper Range Co., in explaining increased costs, stated that ¾c. per lb. of the cost of copper was represented by construction expense, including electrical and metallurgical equipment and new dwellings for employees, which totaled $337,372.

Barnes King Development Co.'s annual report for 1916 shows a net profit of $96,338.22 as compared with $147,968.42 during 1915. The decrease is due to shrinkage in tonnage and value of ore in the North Moccasin property and a further loss with the Piegan-Gloster mine. Dividends paid during 1916 amounted to $60,000 and the surplus at Dec. 31, 1916, stood at $324,824 as compared with $288,486.77 at the end of 1915.

Gold extraction from 75% oxidized ore with under ½ lb. per ton cyanide consumption at the North Moccasin amounted to 86.5%, with a milling cost of $1.337 per ton, compared with $0.882 in 1915. A total of 14,918 tons of ore was mined and milled at the Kendall of an average grade of $2.50 per ton for which the company received a royalty. Extensive additions were made to the Piegan-Gloster cyanide plant and a saving of 95% of the gold and 68% of the silver is recorded at a cost of $1.711 per ton compared with $1.487 in 1915. Ore reserves at the Shannon above the 400-ft. level have been estimated at 26,000 tons. At the Piegan-Gloster the ore reserves west of the shaft and above the 400-ft. level were estimated at 5500 tons of $8 grade, or better as at Jan. 1, 1917.

Temiskaming Mining Co., Cobalt, Ont.—Annual report for 1916 shows a production of 1,263,848 oz. of silver during the year. Of this amount high-grade ore produced 630,417 oz. and 333,431 oz. was recovered from milling operations. The average cost of production was 26.4c. per oz. Dividends paid during the year amounted to $225,000.

Yellow Pine Mining Co., Goodsprings, Nev.—Annual report for 1916 shows total net receipts of $986,315 and total costs, $220,063, leaving a profit balance of $766,252. Dividends disbursed were $800,000, and production was the largest in the history of the company. A total of 20,581 tons was treated in the mill, carrying 10.5% lead, 30.4% zinc and 4.53 oz. silver per ton.

Mount Lyell Mining and Railway Co., Tasmania—Report of the annual meeting held on Dec. 8, 1916, shows output of 3173 tons of blister copper for the half-year; ore reserves, 3,260,267 tons. The net profit for the half year, £128,000, compares favorably with that for the previous semester, £110,000; and £80,574 was distributed in dividends on Dec. 20, as compared with £129,000 on June 29 last. Liquid assets show a decrease of £10,000.

Victoria Copper Mining Co., Michigan—Report for 1916 shows that the copper production, 1,661,832 lb., constituted a record. The profits for the year were, however, reduced to $85,330 on account of heavy expense incurred in construction, equipment and development work, which cost $91,476. The net profit, as stated, plus the surplus from the previous year totaled $197,611, of which $163,001 is represented by cash and copper in hand.

Arizona Copper Co., Clifton, Ariz.—Report for the year ended Sept. 30, 1916, shows a surplus for the year of £630,589, out of which preferential dividends absorbed £24,531. The net surplus, £606,058, added to the balance from the previous year gives a total surplus of £747,469, out of which it is recommended that £303,379 be paid in dividends on ordinary shares and the balance, £443,490, be carried forward. The production for the year amounted to 3039 tons of bessemer copper and 9039 tons of electrolytic copper, representing 7½ months of work. The loss of balance of time was on account of strikes.

La Salle Copper Co., of Michigan, shows in its report that the receipts of the company for 1916 were: From sale of silver, $13,843; from sale of 1,380,352 lb. copper at 25.68c. per lb., $354,409. Expenses incurred during the year amounted to $289,398, making a net profit for the year of $78,855, which was carried to current assets. There was 155,719 tons of rock extracted from the mine, 93% of which was milled, producing an average of 9.53 lb. of refined copper per ton, at a cost of 19.96c. per pound.

McIntyre Porcupine Mines, Ltd., Schumacher, Ont., has issued a memorandum to shareholders dated Jan. 19, 1917, recording the consolidation of the McIntyre properties (Extension, Jupiter and Porcupine), whose property and assets are now vested in the McIntyre Porcupine Mines Co., Ltd., with an increased share capital of one million shares. The handling of 33,558 tons of McIntyre ore during the last quarter of 1916 resulted in an operating profit of $188,774, to which may be added the profit from milling customs ore and from subsidiary company operations of $20,217, making a total of $208,990. A dividend of 5% was paid on Feb. 15, 1917.

Santa Gertrudis Co., Pachuca, Mex.—Annual report for year ended June 30, 1916, shows profit for the year of £42,057, to which may be added the amount brought forward from the previous year of £55,394, making a total of £97,451. A dividend of 1s. per share absorbed £75,000 of this and directors' remuneration £420 11s., leaving a balance to be carried forward of £22,030. The company owns the Compañia de Santa Gertrudis, S. A., whose ore reserves are estimated at 1,214,000 tons with 1.22 dwt. gold and 12.25 oz. silver, assay content, as of June 30, 1916. The disturbed political situation in Mexico during the period under review resulted in work being confined to the development and production of ore. The labor supply has been insufficient and wages, cost of materials and taxes have all increased. The company holds a considerable amount of shares in the Compañia Beneficiadora de Pachuca. A total of 227,616 tons of ore was milled from which 12,660 oz. of gold and 2,286,450 oz. of silver was recovered. Shortage of ore supply was responsible for reduced capacity coupled with a general shortage of supplies. The substitution of cast-iron balls in tube milling in place of mine rock and the introduction of flotation received attention from the metallurgical staff during the year; improved results and saving in costs are anticipated to follow their adoption.

Portland Gold Mining Co., Victor, Colo.—Report for 1916 shows a gross profit from mining operations of $746,703 and revenue from other sources, $22,106, making a total of $768,809. Dividends amounting to $420,000 were paid, and the balance as of Dec. 31, 1916, was $341,753, as compared with $483,502 at the end of the previous year. A total of 418,937 tons of ore was mined and handled by the Colorado Springs and Victor plants. The adoption of flotation for both oxidized and unoxidized ores had been decided upon, but further investigations have demonstrated the inapplicability of the process for the treatment of the former. Plans have therefore been modified, and the cyanide process is to be continued as before. After the completion of reconstruction in June, 1917, it is expected that the two plants will have a combined capacity of 2000 tons per 24 hours.

Consolidated Arizona Smelting Co., of Humboldt, Ariz., states that during 1916 gross income was $3,686,535; cost of operations after crediting miscellaneous revenues, $2,813,770; leaving a profit of $872,765, from which $13,750 was paid on the 6% refunding and improvement bonds, leaving $859,015 net operating profit. The smeltery treated 103,748 tons of ore, recovering 5972 oz. Au, 150,012 oz. Ag. and 11,989,139 lb. Cu, which was just about double the product of 1915. The bullion was made up of 5,829,500 lb. domestic copper from the Blue Bell and De Soto mines and 6,159,639 lb. Cu from the United Verde Extension, Swansea mines and Stoddard Milling Co. Costs of smelting were $3.944 per ton, a large increase over those of 1915, due to a general increase in labor and material and also to the loss of the crushing plant by fire. The Blue Bell mine produced 75,070 tons of ore with an average content of $1.70 in gold and silver values and 3.278% Cu, at a cost of $3.565 per ton. Development work added 319,570 tons of ore to reserves, at a cost of 84c. per ton for ore produced during the year. The De Soto mine has developed 72,882 tons of ore, while 34,382 tons were being extracted, the average content of the production for the year being $1.58 in gold and silver values and 3.375% Cu at a total cost of $3.358 per ton. The mill treated 80,304 tons at a cost of $1.51 per ton, including flotation royalty. The recoveries were 80.3% of the gold, 79.9% of the silver and 92.5% of the copper. The average grade of the feed was 3.19 Cu, and the average grade of concentrates produced was 9.68%, the ratio of concentration being 3.28:1. Changes in equipment will increase the capacity of the mill from 220 tons to 500 tons per day and should be effected by March, 1917.

Cerro Gordo Mines Co., Keeler, Calif., has issued its first report as of Mar. 1 covering the 15 months ended Dec. 31, 1916, which is the period since the beginning of active mining operations on company account, Oct. 1, 1915. The cash receipts in the period show a total of $459,789, including the sale of 100,000 shares of stock at $1 per share. The disbursements amounted to $347,412 and included dividend No. 1 of $24,375. Statement of mine production and the net value at the smelteries follows: 1497 tons lead-silver ore, averaging $44.723 per ton; 11,265 tons zinc ore, averaging $23.759 per ton; 27 tons copper ore, averaging $17.722 per ton; 9431 tons slag averaging $4.282 per ton; miscellaneous earnings of $8641; making the total earnings $359,789. Deducting the miscellaneous earnings, the net cost of all ore mined was $11.08 per ton, showing a net profit from ore production, exclusive of depreciation and depletion, of $217,128, or $17.654 per ton. The cost of sorting, tramming and loading slag into tramway bins at the railroad station at Keeler was about 57c. per ton, showing a profit on slag shipments of $3.71 per ton, or a total profit on slag of $34,987. Slag is not a live production of the mines, but the remains of the old smelting plants that were in operation about 40 years ago. Exploration work cost was $5.80 per ft. and development cost, $16.70 per ft. All work in ore, other than stoping, is included in development costs. A large amount of sorting ore from waste and lead-silver ore from zinc ore accounted for the high cost of development. The direct stoping cost was $5.45 per ton, and the same conditions of sorting apply as in development. The company had on hand Dec. 31, 1916, $112,237 in addition to $48,074 due from ore and slag in transit. Two dividends were declared during 1916, one of which was paid Sept. 20, 1916, amounting to $24,375; the other declared Dec. 22, 1916, payable in 1917.

Osceola Consolidated Mining Co.'s annual report for 1916 indicates a production of 19,586,501 lb. of copper. Gross receipts amounted to $5,065,134.01. Dividends paid for the year amounted to $1,826,850, and increase in current assets, $949,309.55. Tonnage treated amounted to 1,284,681 as compared with 1,361,089 in 1915 and total cost per lb. of refined copper was 11.69c. as compared with 10.03c. in 1915.

Bingham Mines Co.'s annual report for 1916 shows net receipts from ore shipments as $205,261.55, which when augmented by royalty and rent revenues amounts to $251,442.92. Net operating expenses are given as $107,691.08, showing a balance of $143,751.84, from which a mine development expense of $23,904.42 may be deducted, leaving a net operating gain of $119,847.42. Dividends on mining stock held netted $65,912.50 in addition. Interest, premiums, and depreciation are debited with $35,981.12, leaving a surplus balance as at Dec. 31, 1916, of $400,224.23 as compared with $250,442.43 at the end of the previous year.

The Magma Copper Co., of Superior, Ariz., in its annual report for 1916, shows that during the year 8,473,580 lb. of copper was produced at a profit of 13.919c. per lb., making a total of $1,179,508. The average selling price of copper was 24.772c. and the cost of production 10.803c. per lb. The ore reserves are supposed to contain 125,000 tons containing 6.25% Cu, 6.50 oz. Ag, 0.03 oz. Au, 20,000 tons containing 13.5% Zn, 2% Pb, 12 oz. Ag, both stated to be "reasonably assured." Also 7500 tons containing 0.4% Cu, 30 oz. Ag, 2.2% Pb, 6.1% Zn and 0.05 oz. gold, stated to be "probable" ore. During the year dividends amounting to $480,000 were paid to the holders of the 240,000 shares of stock outstanding.

Mount Bischoff Tin Mining Co., Tasmania, reports a profit of £4137 from operations during the last half of 1916, from which, together with interest received amounting to £232, a dividend of £1500 was paid. The mill treated 50,807 tons of ore which produced 233 tons of concentrates. The smeltery treated 1674 tons of tin oxide, producing 1158 tons of 99.884% tin. If the tin content in the concentrates produced by the company operations can be considered as having the same general average of all oxides treated at the smeltery, the ores milled would have contained approximately 0.39% tin per ton. Tests of glass-topped concentrating tables showed a marked efficiency in the separation of pyrites from tin oxide.

Broken Hill Proprietary Co., Ltd., of New South Wales, Australia, reports that for the six months ended Nov. 30, 1916, net profits of £156,430, after allowing £15,169 for depreciation. During the period £325,969 was expended in construction, the principal item being £318,732 in connection with the Newcastle Steel Works. Debentures to the amount of £400,000 were issued for the duplication of the blast furnaces at this plant, and the report is largely given over to the steel plant and allied departments. At Broken Hill 110,276 tons of ore was mined, 97,630 tons of which was milled, producing 17,065 tons lead concentrates containing 58.73% Pb and 28.12 oz. Ag per ton. The zinc flotation plant, put into commission toward the close of the period, treated 13,232 tons of tailings, producing 2805 tons of zinc concentrates containing 47.41% Zn, 5.72% Pb and 13.02 oz. Ag per ton.

Camp Bird Limited's directors' report and statement of accounts for the year ended June 30, 1916, shows an available profit for the period of £138,684 13s., to which is added the sum of £6589 16s. 7d., making a total of £145,274 9s. 7d. A balance of £85,028 14s. 7d. has been carried forward, and the remainder has been distributed among preference dividends Nos. 9 and 10 (£45,473 15s.), directors' remuneration of 1% on £46,726 4s. 9d. (£467 5s.) and income tax (£14,304 15s.). The No. 3 shaft having, at the ninth level, reached the limit of depth with existing equipment, and as it is desirable to develop the mine at depth, a company has been incorporated in America with a capital of $50,000, to which Camp Bird, Ltd., has subscribed £10,245 5s. 9d.; for the purpose of driving an adit to reach the Camp Bird vein at a point 450 ft. below the ninth level. The ore available for milling was exhausted during the year and no additional ore developed. Work in the mine has ceased pending the completion of the adit. The tonnage milled amounted to 25,601, from which a profit of £94,945 was obtained. The recovery from the ore milled (£6 7s. 6d. per ton) is well above the average for the past 14 years, with a corresponding increase in expenditure per ton. The recovery of gold amounted to 97.13% and that of silver and gold to 95.19%. An increase in percentage of total value extracted by an algamation from 58.48% to 63.88% is reported, with a corresponding decline in recovery by concentrators and cyanidation. The company holds 75% of the issued capital of the Santa Gertrudis Co., Ltd., and 29,944 shares on the Messina (Transvaal) Development Co., Ltd.

Tincroft Mines, Ltd., report for the half year ending Dec. 31, 1916, a loss of £1190 13s. 2d. as against a profit of £3691 1s. 4d. for the previous half year. Extensive development work carried out accounts for the difference, coupled with a reduction in grade of ore handled, and a reduction in price received per ton of tin.

Mount Morgan Gold Mining Co., Queensland, Australia—Report for the semester ended Nov. 26, 1916, shows total revenue from all sources of £643,990 and expenditure, including development and depreciation of £502,475, leaving a surplus of £141,515. Dividends paid during the period amounted to £100,000, the balance from the previous account was £36,781, and the balance carried forward £78,297. A total of 152,410 tons of material treated at the smeltery yielded 4554 tons of copper and 54,746 oz. of gold. The costs per ton of ore averaged 50s. 10.99d. as compared with 47s. 10.7d. for the previous half-year. The ore reserves as of Nov. 26, 1916, have been estimated at 4,176,795 tons carrying 2.59% of copper and 6.17 dwt. of gold as compared with 4,333,600 tons carrying 2.6% copper and 6.18 dwt. gold at May 28, 1916.

The Goldfield Consolidated Mines Co., Goldfield, Nev., in its annual report for 1916 shows that the property produced 338,680 tons of ore of a gross value of $2,548,425. Metallurgical losses, smelter discounts, cost of ore purchased and amounts paid lessees aggregated $340,910. Expenses of mining and realization were $1,778,895, leaving a net realization of $428,619. No dividends were paid during the year, owing to reduced earnings and the desire of the management to conserve its financial resources to the end that other possible operations may be instituted which will permit greater earning capacity. At the close of the year the company's reserve was $1,021,086, together with $358,700 loaned to subsidiaries. A total of 338,680 tons of material was milled, composed of 306,600 tons of ore produced from the company underground operations, 691 tons produced by lessees and 31,132 tons recovered from dumps. The total tonnage milled had a gross value of $7.52 per ton, from which $6.53 was recovered, the costs being composed of the following items:

	Per Ton of Ore Handled	Per Ton of Total Ore
Mining	$3.00	$2.72
Transportation	.06	.06
Milling	1.53	1.53
Concentrate treatment	.34	.34
Marketing bullion	.03	.03
Marketing byproduct	.01	.01
General expense	.34	.34
Bullion tax	.03	.03
Moving dumps	.42	.01
Moving tailings dumps	.17	.01
Property tax	.03	.03
Filter royalty	.04	.04
Flotation royalty	.02	.02
Leasing expense	.98	.00
Total operating cost	.....	$5.17
Miscellaneous earnings	.22	.22
Net operating costs	.....	$4.95
Construction	.23	.23
		$5.18
Cost of ore purchased	$0.01	.....
Exploration and development	.07	.08
Total cost	.....	$5.26
Net realization	.....	1.27
		$6.53

The operating results as compared with 1915 show a decrease in net realization of $1,105,574, a decrease in tonnage of 51.374 tons, a decrease in grade of ore of $2.99 per ton and 6270 ft. less development work done. Actual cost of stoping shows a decrease of 11c. per ton; whereas total cost including construction shows an increase of 16c. per ton. Cost of underground mining shows a reduction of 10c. per ton, this reduction being accomplished through "increased efficiency and the reduction of development work." The mill treated an average of 928 tons per day and recovered 86.77% of the values in the ores, at an increased cost of 23c. per ton over that of 1915, due to decreased tonnage and increased cost of supplies. "Measurable ore in sight" is given as 85,000 tons, whereas 300,000 tons is considered as probable, before milling operations will cease. It is interesting to note that the average net value of all ores mined and treated since 1908 has been $11.95, as against $1.34 for 1916.

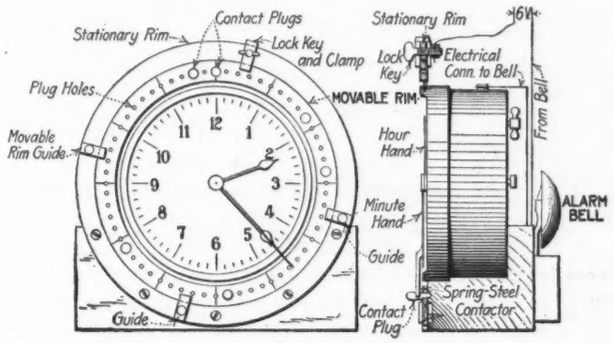
Details of Milling and Smelting

A Filter-Cycle Clock

By Arthur C. Daman*

In Merrill filter practice the necessity of observing the exact time stages of the filter cycle is extremely important. The overcharging of a press for a few minutes will often cause it to become plugged, necessitating a long sluicing period to clean it.

To aid the filterman I have designed a cycle clock in which the different filter events are marked on a movable disk in which plugs are inserted for the different time periods. Electric contact is made between the minute hand and these plugs, ringing a bell which informs the filterman of the change to be made. Holes are placed at



A FILTER-CYCLE CLOCK

all minute spaces and the various lengths of the different stages can be adjusted by means of the plug contacts. As this rim is movable, the filter cycle can be started at any particular time by revolving the rim and then locking it into place with the key. The clock is insulated from both movable and stationary rims.

The accompanying sketch shows the following filter cycle: Nine min. charging; 5 min. barren wash to pregnant gold tank; 15 min. barren wash to mill tank; 10 min. water wash to mill tank and 19 min. sluicing period; a total of 58 min.

If several filters are used and the cycles are less than an hour, these clocks become indispensable, using one clock for each filter.

Steel Balls as a Substitute for Flint Pebbles

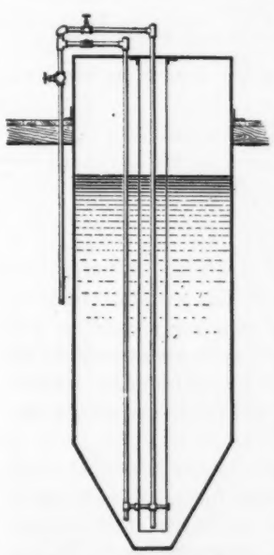
By Algernon Del Mar†

As foreign flints cannot now be obtained and as domestic pebbles have proved a poor substitute, where suitable rock is unavailable it is sometimes necessary to use iron or steel balls in cylindrical mills originally designed for use with pebbles. If these mills had been more massively constructed and the driving mechanism had been capable of a considerable overload, the substitution would have resulted in no ill-effects. On the other hand, it is impracticable to fill the usual tube mill with steel balls to the same level as when flints are used. Although the capacity for grinding per horsepower may be greatly increased, the power available may be far below the requirements. In addition, the tube may not have been constructed of a strength sufficient to withstand the extra weight, and the driving belts may lack enough friction surface on the pulleys to sustain the overload. It is then necessary to either lessen the effective diameter of the mill with a wooden backing faced with steel lining or to maintain a smaller pebble load. The former method is by far the more practicable because a subnormal load in the mill means high power consumption per ton of ground.

An example of the change was shown in a case where a 5 x 8 ft. tube mill, about half full of pebbles weighing three tons, ground 40 tons per day to a certain fineness. By substituting steel balls the same output was maintained, but the increased power necessary was apparent.

Pachuca-Tank Air Connections

Pachuca-tank air connections are often unnecessarily complicated. One of the simplest and most effective systems is illustrated herewith. Both air pipes discharge downward. The absence of bends and elbows below the slime level prevents undue choking and obviates the necessity for any "bicycle" or ball-valve arrangement at the air exit. The operation of the lift is due to the simple mixture of air and pulp. Pressure of air, beyond that necessary to overcome the hydrostatic pressure of pulp, unnecessary during ordinary operation. The lift air-supply terminates a few inches above the bottom of the lift tube, and it is advisable to bolt a "spider," fitting very loosely into the lift pipe, to the bottom of the air pipe in order to keep the latter in a central position. The second air service, to be used in starting up after a long stop, extends to the bottom of the tank and terminates on a level with the bottom of the lift pipe. Both air services are arranged with T-pieces in the manner shown. By removing the plug, filling the air pipe with water, replacing the plug and turning on full air pressure, it is usually possible to clear the air pipe even after an extended shutdown.



AIR CONNECTION FOR PACHUCA TANK

The pipes should be attached by unions immediately below the T-pieces, to facilitate the removal of the air piping if necessary.

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Specific Gravity of Ores

By H. D. Pallister*

One of the problems frequently encountered in working with minerals, ores, etc., is the determination of specific gravity. This is a comparatively simple matter if one has a clean piece of the material that can be weighed in air and then in water and the value found by the formula,

$$Sp.gr. = \frac{weight\ in\ air}{weight\ in\ air - weight\ in\ water}$$

Again, where the material is crushed and is coarse and clean, the determination can be made by weighing some of the coarse material and then dropping it into a vessel filled with water to a certain mark and having graduations above this mark to indicate the increase in volume due to the water displaced by the material added. The specific gravity is then found by dividing the weight of the material by the weight of the volume of water that it displaces.

$$Sp.gr. = \frac{weight\ in\ air}{weight\ of\ volume\ of\ water\ displaced}$$

The temperature at which these determinations are usually made is either 4° C. or 62° F., where great accuracy is required. Results made at 62° F. may be reduced to those at 4° C. by multiplying by 1.00112. This is seldom necessary for ordinary determinations, as the temperature effect is slight. In these methods weights and volumes are used that have a known relation. The common course is to use grams and cubic centimeters, since at greatest density temperature, 4° C., 1 c.c. of water weighs one gram, so that

$$Sp.gr. = \frac{weight\ in\ grams}{(weight)\ number\ of\ cubic\ centimeters\ of\ water\ displaced}$$

One cubic foot of water at greatest density is assumed to weigh 62.5 lb. for most work.

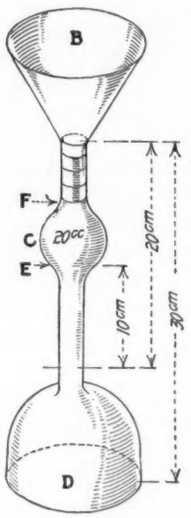
$$Sp.gr. = \frac{0.016 \times weight\ in\ pounds}{number\ of\ cubic\ feet\ of\ water\ displaced}$$

Using pounds and gallons of water, we have

$$Sp.gr. = \frac{0.12 \times weight\ in\ pounds}{number\ of\ gallons\ of\ water\ displaced}$$

One of the sources of error of the methods cited is due to the adherence of small bubbles of air to the material submerged in the water with greater apparent displacement and, as a result, an apparent lower specific gravity. This becomes more difficult to avoid in the finer materials.

Some time ago I had occasion to determine the effect of a series of concentration tests on specific gravity. In searching for a method to determine the specific gravity, I was unable to find a satisfactory one. Finally it occurred to me to try a method that I had used on the determination of the specific gravity of cements. This method was the one that was recommended in the reports of the Committee on Uniform Tests of Cement, of the American Society of Civil Engineers.[1] This is known as the Le Chatelier method. After experimenting with this method, I found it satisfactory on fine sands, ores and concentrates. The only apparatus required are a special flask, a funnel and a bottle of benzine. The flask is illustrated in the accompanying drawing and can be purchased for a small sum from one of the chemical- or physical-instrument supply houses. It consists of the part D of about 120 c.c. capacity, a neck about 9 mm. in diameter and about 20 cm. long, with a bulb C with a volume between the marks E and F of 20 c.c. The neck above F is graduated to 0.1 c.c. for a distance of the equivalent of 3 c.c. The stem of the funnel B enters the neck of the flask and extends to the top of the bulb C. Use benzine (62° Baumé naphtha) or kerosene free from water. I have found benzine better on ores. During the operation, in order to avoid variations in the temperature of this liquid the lower part of the flask is kept submerged in a jar of water. The American Society of Civil Engineers gives two methods of manipulation for cement as follows: a. The flask is filled with benzine or kerosene to the lower mark E. Weigh out 64 grams (2.25 oz.) of the cement powder, cooled to the temperature of the liquid. Through the funnel B introduce the cement powder gradually until the surface of the liquid reaches the upper mark F. Next weigh the cement remaining. Then 64 minus the weight of cement remaining equals the weight of cement that has displaced 20 c.c. or its equivalent, 20 grams, of water, and



SPECIFIC-GRAVITY APPARATUS

$$Sp.gr. = \frac{64\ grams - weight\ in\ grams\ remaining}{20\ (c.c.)\ grams}$$

b. Or, fill with liquid to the lower mark E as before. Add the entire 64 grams of cement powder. The liquid will rise to some division of the graduated scale on the neck, say X. The specific gravity is then found by dividing 64 grams by the sum of the liquid displaced in the bulb and graduated tube.

$$Sp.gr. = \frac{64\ grams}{(20 + X)(c.c.)\ grams}$$

Either of these methods can be used on cements, in which the specific gravity is seldom below 2.7 or above 3.2.

In determining the specific gravity of ores, concentrates, etc., I found that it was better to use the first method, as the range of application was wider and by using 100 grams instead of the 64 grams suggested for cements, I was able to determine the specific gravity of any substance up to and including 5, which figure is seldom exceeded in concentrates. In these rare cases more than 100 grams can be taken, remembering that each 20 grams of material adds another unit to the specific gravity. On the basis of 100 grams of ore the formula is

$$Sp.gr. = \frac{100\ grams - weight\ in\ grams\ remaining}{20\ grams}$$

If benzine is used, it has practically no effect on the ore and the sample can be dried and used for other tests.

*Professor of geology and mining, Texas State School of Mining and Metallurgy, El Paso, Tex.

[1]Trautwine's "Civil Engineer's Pocket Book," 19th edition, p. 942. Also "Coal Miner's Pocket Book," 11th edition, p. 204.

Correspondence and Discussion

Wave System of Power Transmission

Some of your readers may wish to know more of the progress of the wave system of power transmission dealt with by me in the *Journal* of Dec. 2, 1916. Unfortunately, almost the whole of the works of the company in England has been commandeered for making munitions and the interesting work in hand has had to be put off.

I am afraid it will not be until after the war that we shall be able to judge of the performance of the system in mining work on any large scale. The dream of ships propelled by the same system and of factories run by it and of a pipe line under the sea working in competition with electric cables to transmit messages, must remain, at present, unfulfilled. There are, however, strong hopes that by means of under-water pumps, any wreck that can be reached and patched up by divers may be raised.

E. M. WESTON.

Randfontein, South Africa, Mar. 15, 1917.

Standardization of Copper-Mining Companies' Reports, Accounts and Costs

I believe there should be an endeavor made to get the larger mining companies to standardize their reports and accounting. For instance, as to accounting, there could be considered the following:

1. The dividing of accounting into operative and administrative accounting.

2. The maintaining of uniform operating departmental accounts, such as development, ore extraction, milling, ore transportation, smelting, refining and selling, and operating overhead.

3. The establishing, as near as possible, of uniform departmental unit accounts for cost purposes, such as, for ore extraction, stoping, tramming and tracks, station tending and caging, top landing and tramming, pumping, maintenance of shafts and drifts, general underground, surface, engineering, assaying and supervision.

4. In making, as near as possible, uniform charges to all departmental unit and departmental accounts.

5. In segregating the charges to the departmental unit accounts into labor, supplies, power, repairs, replacements, and expense.

6. In having uniform cost factors for determining departmental unit and departmental costs.

7. In keeping efficiency and production factors, such as feet advanced per man-shift drifting, etc.

This would insure uniform compiling and analysis of operations, which is necessary to intelligent and accurate accounting and costing, both of which are invaluable to efficient management and production in any business requiring a large working force. Also, it would make the costs and detailed reports of each company of value to all other companies working under similar conditions and methods, as well as allow the stockholders and investors to compare the results as shown by the yearly reports with the results obtained by other companies operated under similar conditions and methods.

It might be contended that no standardization of mine or other departmental unit accounts could be obtained: First, on account of some companies requiring or desiring finer segregations of the departmental unit accounts; for instance, instead of carrying one account for tramming and tracks, there would be accounts for tramming ore, tramming waste and underground tracks. However, this could be met by each company carrying as many subdepartmental unit accounts as it might desire. Second, due to the fact that operations are not carried on at all mines under similar conditions and methods. This could be met by grouping the mines as follows and agreeing upon standard reports, accounts, etc., for each group:

As to method of mining: (1) Mines being worked by means of shafts, drifts and stopes; and (2) mines being worked by surface pits, using steam shovels or hand labor.

As to character of ores mined: (1) Mines producing direct smelting ores; (2) mines producing concentrating metallic ores; (3) mines producing concentrating smelting ores; and (4) mines producing leaching ores.

As to method of disposing of products: (1) Mines selling their products to smelters; (2) mines smelting their ores and selling their products.

Before a person can properly detail any one of the departments of the work of mining, I believe it is necessary to have a clear idea of the business as a whole and to separate it into its grand divisions of operation and administration, and then subdivide operations into engineering, purchasing, production and selling, and administration into management, accounting and finance; then to determine the exact scope, purpose and functions of the work of each department or subdepartment of operation.

Therefore, in detailing accounting, it is first necessary to remember the purposes of accounting, which are: To verify and check, analyze and record, the business transactions and the operations in such manner as to show at regular intervals a true, correct and intelligent statement of the condition of the business and the results of operations in costs and earnings; to furnish to the manager and to the different department heads the results of operation for each period, within such time as to enable them to utilize the knowledge obtained therefrom in the succeeding period; to summarize and compile the results of the operations of each period and report to the manager and directors the fluctuations when compared with previous periods.

To obtain a correct picture of the business, it is necessary to follow the principles that underlie the operations of the business, and as the business consists of operation and administration, it is necessary also to divide accounting likewise.

The different phases or stages of the operations of the mining business are disbursements, production, sales,

receipts and cash, and the business continually flows through these different stages as long as operations last. Therefore the object of accounting is to divide the operations into distinct periods and to show at the end of each period the condition of the business, the resultant profit or loss and the details of the operations in costs and earnings.

While this can be done intelligently and efficiently only by following the principles of the business as mentioned, and not by following arbitrary accounts, systems, forms and records nevertheless there must be accounts, schedules of charges thereto, etc., and these should be determined to conform to the principles of the business and be, as near as possible, uniform for each group of mining operations.

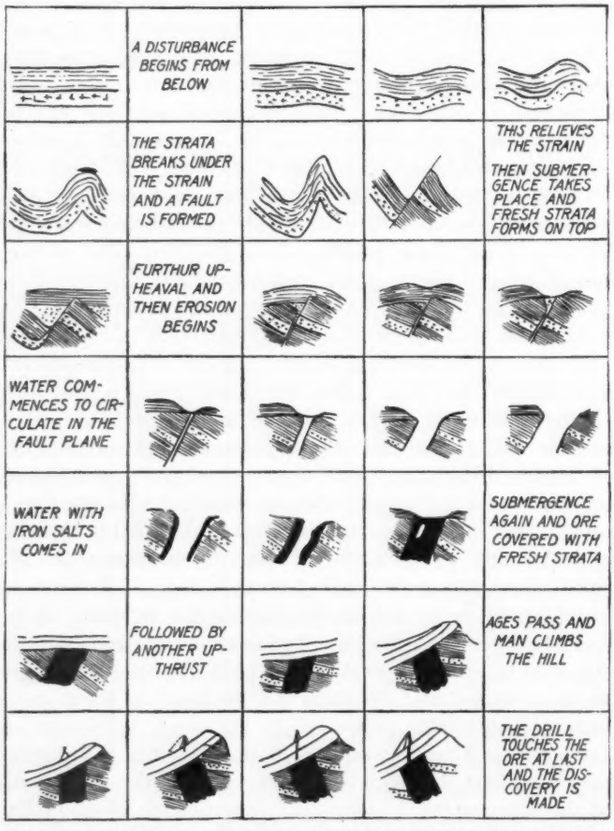
If such standardization of yearly reports, accounts and costs were obtained, then the accounting data of each company would be valuable not only to the management, the department heads and the stockholders of each company, but to investors and to the management and department heads and stockholders of all other companies operating under similar conditions and methods.

T. O. McGrath.

Shattuck Arizona Copper Co., Bisbee, Ariz., Mar. 24, 1917.

Built-up Motion Pictures in Mining

A suggestion is made that the mining world might get behind a movement toward the illustration of its work by means of built-up or drawn motion pictures. Most of us


A DISTURBANCE BEGINS FROM BELOW
THE STRATA BREAKS UNDER THE STRAIN AND A FAULT IS FORMED
THIS RELIEVES THE STRAIN
THEN SUBMERGENCE TAKES PLACE AND FRESH STRATA FORMS ON TOP
FURTHUR UPHEAVAL AND THEN EROSION BEGINS
WATER COMMENCES TO CIRCULATE IN THE FAULT PLANE
WATER WITH IRON SALTS COMES IN
SUBMERGENCE AGAIN AND ORE COVERED WITH FRESH STRATA
FOLLOWED BY ANOTHER UPTHRUST
AGES PASS AND MAN CLIMBS THE HILL
THE DRILL TOUCHES THE ORE AT LAST AND THE DISCOVERY IS MADE

BUILT-UP MOVIE OF THE WORLD'S GREATEST DRAMA

have noted the work of the Bray studios and others, and have watched the simple but extremely interesting picturing of the building of a bridge—to mention only one of many subjects so treated. In those pictures we saw quite clearly and in an educative manner what bridge building means. Piece by piece we saw the progress of the work and the steps that had to be taken to carry it along. Could not something similar be done in mining?

We are all agreed that better education of the general public to what is implied in many mining projects is a desirable object to attain, but we also agree that while the will is there the difficulty has been to carry such a program to a practical conclusion. The technical journal gives no help because the public never reads it. But the motion picture—that is, the educative motion picture—seems to offer a somewhat feasible alternative to simply doing nothing. The sketch attached, with some steps omitted since otherwise the picture would be too long, might serve as an illustration of the manner in which the work could be done. J. F. Kellogg.

Philadelphia, Penn., Mar. 19, 1917.

Analysis of Aluminum Dust

In reference to my article on "Analysis of Aluminum Dust" in the *Journal* of Mar. 27, 1917, I have had occasion, since writing it, to note the presence of manganese in several samples of dust submitted to me. I am now working on a scheme to provide for its estimation in our product, which I hope to present later.

There are a few typographical errors in the original article, and while none of them are very important, one or two might cause trouble to anyone attempting to carry out the system described. On page 496, column 1, line 44, the word "nitrate" should be "nitride." In column 2, line 38, "some paper" should be "same paper," and in line 44, "add 50 c.c." should be "add 5 c.c." On page 497, column 2, line 20, I should have said "boiling" instead of "leaching." On page 498, column 1, line 14, "appears" should read "disappears"; line 29, "a little chloride" should read "a little barium chloride," and at line 51, after "evaporated" should be inserted, "with HCl." On the same page, column 2, line 41, "add 5 c.c. water," should read, "add 50 c.c. water." On page 499, column 1, after line 14 there should be a heading, "Rapid Colorimetric Method for Iron." On the same page, after line 34, insert a heading, "Special Method for Zinc."

Oakland, Calif., Apr. 5, 1917 J. E. Clennell.

Phosphate Determination with Molybdate

The phosphate chemist usually employs the molybdate method in his daily determinations. The growing scarcity of molybdate appears to make it worth while to point out that there is a method given in Low's "Technical Methods of Analysis" that does not use any molybdenum compound.

The phosphorus is precipitated as ferric phosphate by ammonia with presence of acetic acid, filtered off, redissolved in hydrochloric acid and precipitated with magnesia mixture after adding citric acid to hold up the iron. The method gives accurate results if the first ammonia precipitated is dissolved and reprecipitated, but is a long one as the ferric phosphate filters slowly, even if only 200 mg. of low-grade phosphate rock is used.

Jacksonville, Fla., Apr. 30, 1917. H. H. B.

Events and Economics of the War

The great events of the week were the enactment of the conscription bill, the announcement that a force of our regular troops is to be sent to France as soon as possible under General Pershing, and the formation of a coalition ministry in Russia.

The Russian situation undoubtedly improved greatly, as was signified by the lending of $100,000,000 by the United States to Russia. The coalition ministry, in which Kerensky appears to be the strong man has put a firm grasp on the situation.

In the direct military way, the chief events were further advances by the British and French on the western front and the inauguration of a strong offensive by the Italians on the Isonzo front, threatening Trieste.

The Matter of Taxation

The following excerpts from some recent communications and reports in the daily papers are very illuminating.

It is difficult and ungracious to criticise the severe taxation proposals of your Congress, when they are recognized as a heroic measure, said the London correspondent of the *Evening Post*, on May 12. Yet, in the light of our own experience, it is feared that they are excessive—first for psychological reasons; second because their heavy requisitions may hamper your loan operations.

In England's first "supplementary war budget" of 1914 the income tax was doubled; but it was largely prospective, only one-third applying to the first year of war. In fact, only $80,000,000 of extra taxation was estimated for that period.

Even in May of 1915 no new taxes were imposed; but the previous doubling of the income tax meant addition of about $350,000,000, and when the supplementary budget of September, 1915, was announced, the income tax was raised more than three-eighths further and nearly $350,000,000 fresh revenue estimated. Only in April, 1916, was that tax raised to 5 shillings in the pound, with a much greater increase in the supertax and a total new revenue, including excess profits of $380,000,000. The last budget comprised mainly an increase in the excess profits tax, with a further estimated advance of revenue amounting to $150,000,000.

The following from an editorial in the New York *Sun* of May 18, ought to be printed in red letters, so sound is it.

"Great wealth may have no rights which some Congressmen feel bound to respect, but common sense should tell them that they cannot take vast percentages of large incomes without depriving ordinary and necessary business enterprises of capital as essential in war as in peace. Do they suppose that the million-dollar income is fooled away on personal comforts and luxuries? The recipient couldn't do it if he tried. The bulk of his income is immediately reinvested. It helps railroads buy rails, it opens new mines, it buys new machinery, it is spent in large lumps on new processes which save 5c. here and 3c. there to consumers all over the country.

"Members of Congress say that they wish to eliminate as far as possible taxes on consumption, but do they wish to cripple production instead? Everybody in the country knows that we need, as we never have needed before in our national existence, to double and treble production in important lines. We need also to restrain consumption in these and other lines. Then why is it proposed to let consumption go untaxed and take the money which must be had to make increased production possible? Is this the right principle?

"Such a course will encourage waste and check enterprise. Such a course will paralyze the business of the country. Such a course, if persisted in, will make it necessary for the Government rigidly to limit consumption of basic commodities and will throw on the Government the additional and unnecessary burden of financing industries of all kinds, both those which bear a direct relation to the conduct of the war and those on whose maintenance the general prosperity of the country depends."

Another red-letter pronouncement was made in a communication to the public by Doctor Eliot, president emeritus of Harvard, who said that the poor man, to retain his self-respect, must pay taxes as well as the rich. He denounced tax dodging and said that the tax dodger with a small income will become "morally pauperized." Doctor Eliot's letter continued as follows:

"If then the great majority of the voters, who are always of moderate or narrow incomes, use their power to avoid paying any taxes themselves they will surely lose their self-respect and those sturdy, independent, honest and just qualities which alone befit freemen.

"By their own selfish and mean action they become morally pauperized. The action of the American democracy on income tax already shows signs of this insidious demoralization.

"The poor get their comforts and luxuries to a large extent out of public expenditures. If they have not knowingly contributed to the public income they are getting these comforts and luxuries out of an income which is not their own."

On May 22 the Washington correspondent of the *Evening Sun* reported that complete revision of the war tax bill is now assured. Convinced at last that it is poor business to tax business out of business and thereby bring on hard times. Administration leaders have passed the word down the line that the Senate Finance Committee is already at work rewriting the House Ways and Means Committee bill.

The light that has come to the leaders in Congress—or to some of them—has also come to the White House. No longer are the President's friends insisting that the bulk of the war's cost shall be placed on the generation that must bear all the blood cost of the war against

Germany. The President himself, it is said, is more inclined to the view that future generations, in whose interest the war is largely fought, should bear their just share.

In consequence of the change in point of view, business men who have come to Washington in a panic of apprehension over the effect of the unprecedented taxes, are being assured now that the bill in its final shape will not have the effect of strangling industries, and that whatever the total of the taxes they will not be so burdensome as to bring on business depression. The bulk of the taxes, they have been told, will be laid on inheritances, incomes and excess profits. Special taxes, as those laid on special kind of business are known, are either to be entirely abandoned or considerably modified.

In direct and painful fashion the Government has been made to understand the disastrous consequences which threatened from a too severe levy on business. Long haired leaders of the Kitchin type have been loud in their support of the kind of taxation proposed by the House committee, for the reason that such taxation offered what seemed to them to be the best and most effective means of shifting the burden to the larger businesses of the country. They dragged in the name of Wall St. and gloried in the prospect of making Wall St. pay all the taxes of the war. At the same time they voted a bond issue of five billions and a note issue of two billions more.

Much to the dismay of the Government, however, the big business interests of the country, which are ordinarily relied on to absorb Government issues, have not subscribed as abundantly as necessary to the liberty bonds. It was discovered by the Democratic leaders at the capital that business which they were threatening to tax out of business could not with certainty subscribe to large quantities of bonds.

In short, Congressional leaders began to realize a new application of the old adage against "killing the goose that laid the golden eggs." They wanted big business to pour out its gold for the Government bonds at the very moment when they were preparing to tax big business into oblivion. The lesson has been driven home, the Senate leaders declare, and the bill is to be revised—revised downward.

Mobilizing the Railroads

All railroads have been called upon by the war board of the American Railway Association to readjust their service immediately so as to make available the maximum transportation energy for moving fuel, food, material and troops.

A notice to the roads, announced by Fairfax Harrison, chairman of the board says:

"1. Consolidate where practicable through passenger train service and eliminate those trains which are not well patronized.

"2. Reduce the number of special trains and give up running excursion trains.

"3. On branch lines where two trains are operated try to reduce to one train a day.

"4. Where practicable substitute mixed train service for separate passenger and freight service on branch lines. Closely review number of scheduled freight trains where tonnage is insufficient to load them fully, with a view to reducing the number of trains.

"5. Where passenger trains are double headed for speed, a readjustment of schedules or cutting off cars where possible will release locomotives for freight service.

"6. Reduce as far as practicable luxuries such as observation cars. In the interest of economy reduce the present rather elaborate and luxurious bills of fare on many dining cars.

"7. Move 'company' freight on under-loaded trains. Operate work trains as far as possible in slack times. Store coal in slack times.

"8. Make proper train loading of primary importance with officials and train crews. Give publicity to those making good and poor records."

In connection with his announcement Mr. Harrison made this statement:

"The war board, especially organized by the railroads to operate all the roads of the country as one system for purposes of national defense, finds it inevitable that from time to time it must recommend the adoption of policies which may prove inconvenient to the public. In doing so, however, the board will rely upon the support of public opinion. In the present national emergency some sacrifice of individual convenience is necessary to enable the railroads to increase the capacity of their lines and to conserve the fuel supply of the country."

Hoover To Be Food Administrator

President Wilson announced, on May 19, that all the broad powers essential to the solution of the problem of feeding the American nation and its allies would be delegated to Mr. Hoover, who had consented to act only on the provision that he would receive no pay and that his assistants, likewise, would serve without pay so far as it was possible to volunteer workers. With the end of the war the powers of the Hoover commission will cease.

Neither the President nor Mr. Hoover desires the new position to be known as a dictatorship. "I have no instinct to be a food dictator," said Mr. Hoover. "My ambition is to see my own people solve their own problems."

The appointment of Mr. Hoover is of course provisional on authorization by Congress of an emergency food commission with the extraordinary powers asked by the President, and Mr. Hoover's acceptance also was on the assumption that Congress will not see fit to limit the powers which Mr. Hoover regards as vital to a successful administration of the food situation.

President Wilson in a statement announcing his selection of Mr. Hoover stated flatly that it was absolutely necessary that unquestionable authority be placed in his hands to insure an effective solution of the problems which have arisen from the universal shortage of foodstuffs.

Among these powers as outlined by the President are:

Prevention of hoarding, requisitioning of food supplies, establishment of maximum and minimum prices, licensing of agencies handling foodstuffs in any way and if regarded as necessary taking them over for operation under Government supervision, fixing milling percentages for the manufacture of flour, authorizing

the mixture of other cereals with wheat in the manufacture of flour and the elimination of the waste of food materials, as, for example, through the prohibition of reduction of the use of grains in the manufacture of liquor.

"The proposed food administration," said the President, "is intended, of course, only to meet a manifest emergency and to continue only while the war lasts. Since it will be composed for the most part of volunteers, there need be no fear of the possibility of a permanent bureaucracy arising out of it. All control of consumption will have disappeared when the emergency has passed.

"The last thing that any American could contemplate with equanimity would be the introduction of anything resembling Prussian autocracy into the food control in this country."

A statement given out by Mr. Hoover after the White House announcement was made gave his plans for food administration and called on the country to render voluntary assistance in carrying it out. Mr. Hoover proposed that the food administration be divided into four great branches, whose duties he defined in detail. Most of the work would be carried out by men and women of the country on a volunteer basis.

"If this cannot be done," said Mr. Hoover's statement, "I shall certainly and willingly surrender the task to some other method of emergency. I hold that democracy can yield to discipline and that we can solve this food problem for our own people and our Allies in this way, and that to have done so will have been a greater service than our immediate objective, for we will have demonstrated the rightness or our faith and our ability to defend ourselves without being Prussianized."

Five cardinal principles of food administration outlined by Mr. Hoover are:

"That the food problem is one of wise administration and not expressed by the words 'dictator' or 'controller,' but 'food administration.'

"That this administration can be largely carried out through the coöordination and regulation of the existing legitimate distributative agencies, supplemented by certain emergency bodies composed of representatives of the producers, distributors and consumers.

"The organization of the community for voluntary conservation of foodstuffs.

"That all important positions, so far as they may be, shall be filled with volunteers.

"The independent responsibility of the food administration directly under the President, with the coöperation of the great and admirable organizations of the Department of Agriculture, the Department of Commerce, the Federal Trade Commission and the railroad executives."

"I conceive," says Mr. Hoover, "that the essence of all war administration falls into two phases: First, centralized and single responsibility; second, delegation of this responsibility to decentralized administrative organs."

The four branches of food administration are described by Mr. Hoover as follows:

"In the first branch we should set up a certain number of separate executive bodies for regulation and administration of certain critical commodities, and these should be organized on the normal lines of our commercial institutions, with a board of directors, a president and executive officers, who will work out problems involved in these commodities and will institute such measures as may be necessary to stabilize prices and distribution, and that these bodies should be constituted of the leaders of the country, producers, distributors, bankers and consumers alike.

"The second branch of administration lies in the coöperation of the Governors and State administrations through the establishment of state food administrations who will act on behalf of the national Executive in national matters and who will themselves handle local problems through them and their assistants to secure coördination in distribution from one section of the country to another and to use the powers against illegitimate hoarding which Congress is being asked to vest in the food administration. Furthermore, it devolves on the states to stop waste in public places.

"The third equally important department is one of domestic economy. As 90% of the ultimate food consumption of the country is in the hands of the women of the country we will shortly place before them a plan of organization including policies as to the elimination of waste, the reduction of consumption, the substitution of local commodities for those from further afield, the substitution of over abundant commodities for those which we wish to export to our allies, and instruction in the intelligent purchase and use of foodstuffs and to see public opinion against waste and extravagance in public places.

"We do not ask that the American people should starve themselves, but that they should eat plenty, wisely and without waste.

"The fourth branch of the administration must be that of coöperation with our allies, in many important questions involving exports from this country and our common import from other countries. Furthermore, we will probably need to undertake the control of the purchasing in this country on her behalf and on behalf of such neutral shipments as are permitted by the Government in order to eliminate competition and forcing up of our prices."

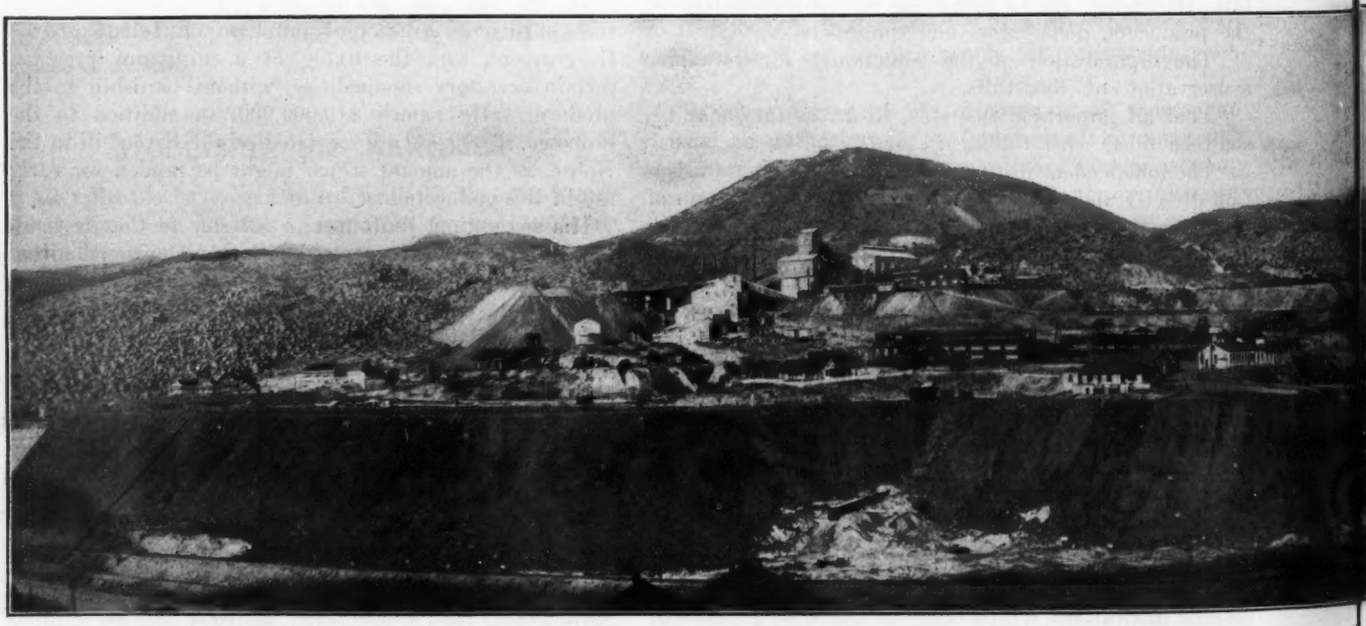
Mr. Hoover wants for his prospective "food administration" the financial backing with which to provide for the contingency of actual purchase on behalf of the Government, and the fixing of a minimum price in certain necessary commodities, without hardship to the producer. He named $10,000,000, in addition to the proposed $3,000,000 appropriated by the Lever bill in the House, as the amount which might be needed for early use in this connection.

His suggestion, contained in a letter to Congressman Lever, father of the proposed bill, which was submitted to the Committee on Agriculture of the House, carried the recommendation that the additional appropriation be made available at once, or that the "food administration" machinery to be created be permitted to return to Congress with the request if the appropriation was found necessary.

As the welfare of the Nation and the Nation's defense are absolutely dependent upon an adequate supply of coal for all purposes, and of iron ore for the iron and steel mills, the Executive Committee of the Special Committee on National Defense, of the American Railway Association, has ordered all railroads of the United States to give coal and iron ore preference over all others.

Old Dominion Copper Works in

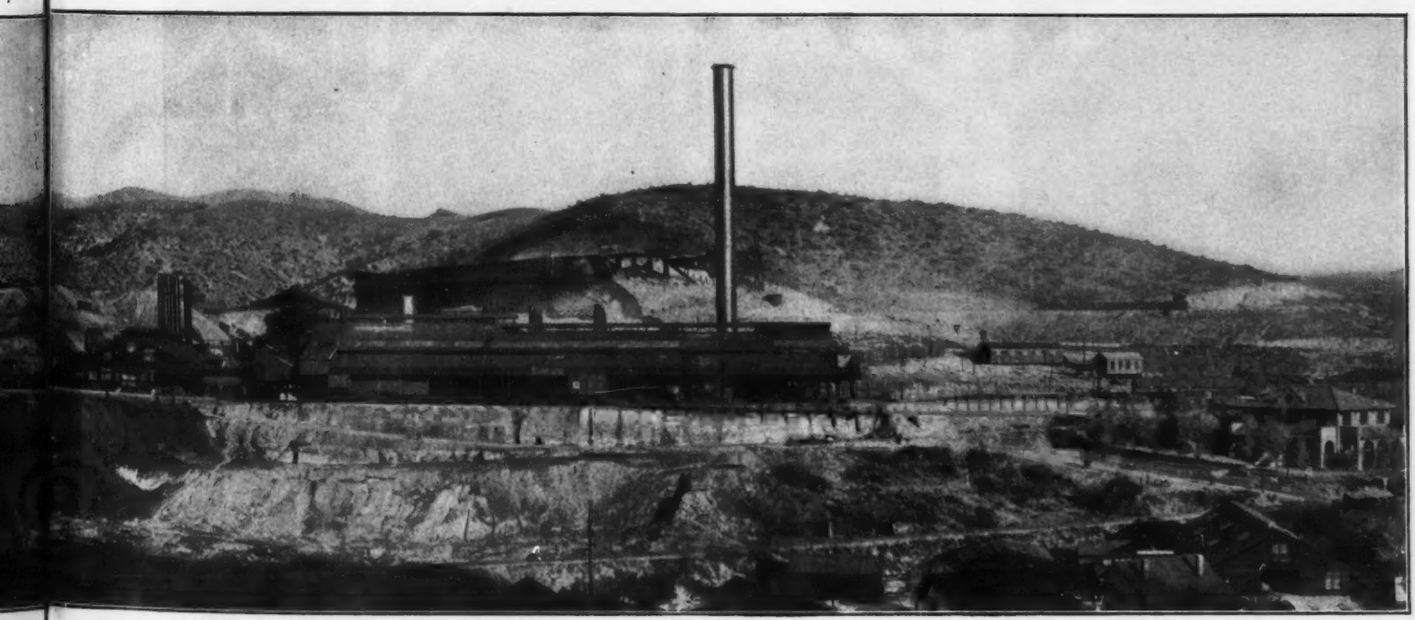
PANORAMIC VIEW OF GLOBE DISTRICT, SHOWING THE TOWN OF GLOBE, THE OLD DOMINION WORKS



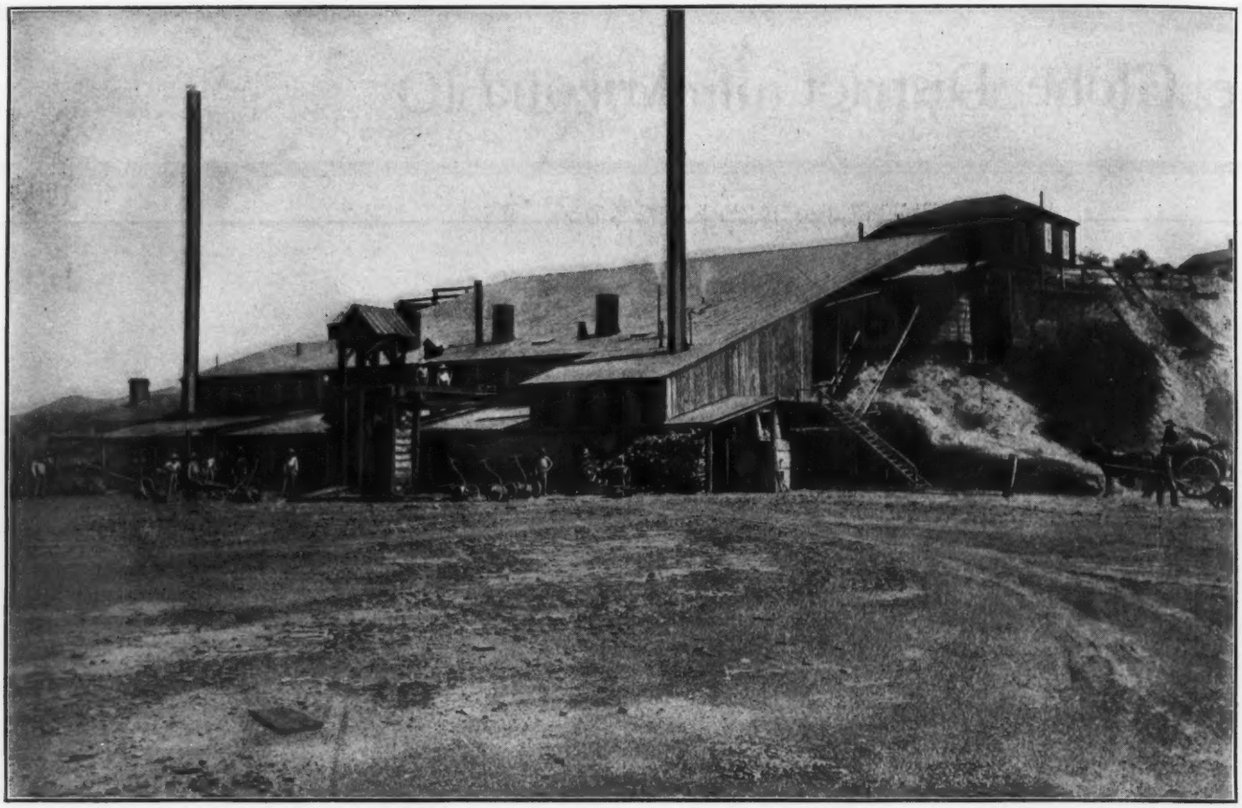
THE CONCENTRATING PLANTS AND COPPER SMELTING

the Globe District of Arizona

AND IN THE DISTANCE THE MIAMI AND INSPIRATION MILLS AND THE INTERNATIONAL SMELTERY



WORKS OF THE OLD DOMINION CO., AT GLOBE, ARIZONA



ORIGINAL COPPER-SMELTING PLANT OF THE OLD DOMINION MINES AT GLOBE, ARIZONA

INTERIOR VIEW OF OLD DOMINION'S EARLY SMELTING WORKS, SHOWING TWO CIRCULAR WATER-JACKETED COPPER FURNACES AND THE HAND SLAG POTS USED IN THE EARLY DAYS

Editorials

We Are at War

We are at war. We have started to fight a real war. It is a life-or-death war. That kind of a war is not going to be conducted successfully by bureaucrats or by politicians or by Congress. It never has been and is not going to be. The bureaucrats should keep quiet. The Congress should do quickly what it has to and then go home.

The President is commander in chief and is responsible for the prosecution of the war. Many powers must be delegated by him. He will have to pick good men to help him. Already he has done so, but he has got a lot of hold-overs whom he would well be rid of. Some of his previous ineptness in picking men is coming home to roost. The country would feel satisfaction if Daniels were retired. It looks, too, as if Denman, of the shipping board, might profitably be dispensed with.

There are high officials in Washington today who say, "I must consider my political future." Let the press publish everything of that sort. The country will then attend to their political future. There will not be any.

There are bureaucrats in the Department of Agriculture who are quarreling with bureaucrats in the War Office over the soldier's ration. Shall it be equal to 2000 calories or 4000? Secretary Redfield publishes bulletins telling us wisely that the cost of carting food from the railway warehouses is more than the railway freight. The Dutch have taken Holland. Blatherskites in Congress say the poor men are required to give their sons, therefore tax the rich men only. Don't the rich men also give their sons? This is the kind of talk that is fuddling Washington.

Kill the politicians. Let the bureaucrats amuse themselves and draw their pay so long as they keep their hands off. Let Congress go home. It can't run the war, and the people do not want it to try to.

Shall We Suspend Assessment Work?

One of the popular reforms suggested during every national crisis has been the suspension of assessment work on mining claims. This comes up periodically but has never been put in actual force in our recollection, except for enlisted men in war time. A reader now comes forward with the following suggestion:

As a war measure, what would be the matter with suspending assessment and location work as long as the war lasts? It would release men for work in more essential things.

This proposal has more force in this instance than at any previous time in which it has been brought forward. Assessment work is not, as a rule, of a productive character so far as the actual development of a prospect is concerned. This work contributes in no wise to the great problem which the nation now has before it, and there is great need for the man power of the country to be applied to constructive enterprises necessary to prepare the United States for war, and help our allies to victory.

The amount of actual good accomplished by assessment work is practically *nil*. It is merely a plan to assure the Government of the earnest intentions of the locator to do something with the property he is holding. Occasionally the work done is of value, but more often the money and labor are merely expended to maintain the equity.

The $100 that is presumed to be spent on a claim is, one might say, practically wasted, yet some form of work or taxation is required to prevent land being held idle indefinitely. The suggestion was made some time ago that the assessment obligations could better be met by depositing with the land office the annual requirement of $100, and when this sum reached a figure which would permit of some really important development that it then be applied to the property and thus accomplish some work of value.

While the present perfunctory assessment work requires a certain number of men, we are not of the opinion that this work will constitute a great drain on the man power of the country. Yet there is no reason why even this small proportion should be wasted. Canada has already released its soldiers from assessment obligations and our Congress is considering doing the same. For others who are not able to offer their services to the country at the front, a plan might be arranged of depositing the $100 assessment with the land office during the duration of the war or, as has been suggested, until such funds accumulate sufficiently to permit some important development work on the claims in question.

Power Used in Mining

The power requirements of mining and milling operations vary in different districts and under different conditions, and no universal standards can be set. For this reason the requirements of different districts are of interest. In a recent article in "General Electric Review," Ben Olsen, of the Spokane office of the General Electric Co., gives some interesting data of the total power consumptions of various companies of the Cœur d'Alene district, Idaho. These figures are not so enlightening as they would have been had they been separated and classified by the departments in which the power is used. The consumption is recorded in totals, however, and includes all the operations carried out at the properties, such as mining, milling, shopwork, etc. The accompanying table shows some of the data compiled from report of the assessor.

POWER CONSUMPTION OF COEUR D'ALENE PROPERTIES

	Gross Tonnage Assessors' Report	Gross Value Assessors' Report	Kw.-Hr. Consumed
Bunker Hill & Sullivan (Silver King)	454,205	$177,819.20	10,979,000
Caledonia	42,628	1,246,859.65	1,478,040
Ontario	81,208	689,392.54	191,100
Federal (Wardner)	136,180	620,682.06	3,424,654
Gold Hunter	118,764	614,590.47	3,506,320
Hecla	146,675	1,422,578.55	3,967,900
Interstate Callahan	113,795	4,540,671.56	3,350,840
D. W. Peoples	15,159	110,328.00	168,297
Success	21,867	1,255,801.78	2,442,560
Totals 1915	1,130,481	$10,678,723.81	29,508,711

Among the data derived from the facts presented, the following are important: Proportion of power cost to net profits of mines, 3.22%; cost of power per gross ton mined, $0.1895; kilowatt-hours consumed per gross ton mined, 26.1; proportion of power bill to gross value of product, 1.46%; proportion of power bill to total cost of mining, 5.52%. Total cost of mining, $3.44 per gross ton mined; proportion of power bill to total cost, 2.82%; total cost, $6.71 mining and milling.

The Liberty Loan

We give much space this week to Mr. Vanderlip's article, for the reasons that the Liberty Loan is about the most important thing before the American people today and Mr. Vanderlip's is the best exposition of the economics of it. This great banker states the case correctly when he says that this loan can not be subscribed for out of capital but must be met out of savings. The essence of his advice is to borrow money, subscribe to the loan, each one according to his ability, and pay off the debt by saving.

Let us add that optimism is an important psychologic factor. If we thought that all things were going to the dogs we should be reluctant to go into debt, although we should have to just the same. But we are cheerful about the prospects. We are going to win this war. Let nobody make any mistake about that. If we did not think so we might lose all we've got, anyhow. This is the time for optimism and courage. Let those fight at the front and work in the fields and shops who can, but let everybody adopt this motto for his own: Borrow, subscribe and save.

Where Was the Fool-Killer?

The following is from a special dispatch to the New York *Times* from its Washington correspondent, May 17. The italics are our own.

"There were indications today that the fight over the selection of Herbert C. Hoover as 'food dictator' might on short notice flare up into a conflagration that would test the power of President Wilson to force his convictions upon a recalcitrant Congress.

"Mr. Hoover and his sympathizers went ahead today with their work on the theory that the head of the Belgian Relief Commission was already as good as named. On the other hand, it was asserted in some quarters, with little effort at concealment, that the opposition voiced in the secret session of the Senate yesterday would come to the front again in greater force if President Wilson made it evident that he was determined to 'put over' Hoover and place in his hands the extraordinary powers conferred on the Government by the Food bill now under consideration.

"It was pretty generally admitted today that there were no developments to indicate that the President was weakening in the stand in behalf of Hoover which it is understood he has taken. That at least was the belief of some of the men who conferred with Mr. Hoover yesterday on various angles of the complicated problem of food supply, distribution and control. They answered questions about the Senate opposition and the likelihood of Hoover being dropped with a smile and a shake of the head. President Wilson, they said, would have his way, and the Senate, after wrangling a bit, would drop the fight.

"Among the anti-Hoover men yesterday's criticism was repeated in a way to indicate that the opposition to him was very strong. Some of the Senators contend that he has had too little experience to fit him for this great work. They say that he succeeded in Belgium as chairman of the American Relief Commission because he had behind him the backing of the United States Government and that any man would have succeeded in those circumstances. Senators who take this position hold that the sensible thing to do is to appoint as Food Controller a man of large business experience who has proved his ability to handle a problem of the magnitude that will confront the food administrator."

The backing of the United States Government! Any man would have succeeded in those circumstances!

Is Hoover a man of small business experience? Has he failed to show his ability in handling problems of magnitude?

Where, oh where, was the Fool-Killer on May 16? Verily he missed an opportunity of his lifetime when he overlooked the Senate Chamber of the Congress of the United States of America. Did he take that day off to go fishing?

Another excited congressman asked, "Who is this man Hoover that there is so much talk about?" Not long ago, in a public meeting, Dr. Raymond remarked, "You don't have to look in Who's Who to find out Who's Hoover," but he was addressing an intelligent audience and did not have Congressmen in mind. We think of starting a society for the illumination of neglected Congressmen. But maybe the Fool-Killer will get back on his job.

Belgian Kiddies, Ltd.

The subscriptions to Belgian Kiddies up to date amount to $90,358. On June 1, as has already been announced by Mr. Hoover, all private subscriptions will close, owing to the financing of the Beligian relief having been assumed by the American Government. This will automatically terminate the Belgian Kiddies subscription. Mining engineers will have the poor satisfaction of knowing that what was started to be a Christmas present of $120,000, has, after five months, succeeded in reaching a sum about $30,000 short of the mark. In such a cause to fail so badly is something that must cause the profession to experience feelings of mortification, without in anyway minimizing the generosity of those who gave. The work of the Belgian relief is to be taken over by the Government, thus satisfactorily crowning Hoover's well directed efforts, and assuring the fullest measure of success he has tried to reach.

When we find ourselves required to exert the maximum of our power and work with the maximum of efficiency it is interesting to note the demand for the repeal of much recent legislation. Thus is the movement to cancel the LaFollette seamen's law, the full-crew laws of several states, and so on. If they were contrary to efficiency, why in the name of common-sense did they ever happen?

Mining Matters at Washington

WASHINGTON CORRESPONDENCE

An investigation of the cyanide situation is to be conducted by the Bureau of Mines. The work will be largely in the hands of Prof. G. H. Clevenger, of Stanford University, who is attached to the metallurgical consulting staff of the Bureau. The work contemplated will include an investigation of production, extensive experimentation and research work and a study of means to prevent waste. Such preliminary information as is at hand shows that small consumers of cyanide throughout the United States are having great difficulty in securing sufficient supplies of the product. The condition of the larger companies is said to be somewhat better.

Suspension of imports of cyanide and the diversion of metallic sodium to war uses are given by manufacturers as the principal causes for the present shortage of cyanide. England is understood to be having difficulty in supplying the needs of South Africa and Canada. An unverified report has reached the Bureau of Mines to the effect that the citrus fruit growers now are using more cyanide than is the mining industry.

Prof. Clevenger, who will be the principal figure in this investigation, is a graduate of the South Dakota School of Mines and Columbia School of Mines. He has been a member of the faculty at Stanford University since 1905, except for short periods during which he accepted private metallurgical employment. He now is research professor and metallurgist at Stanford University. He has been a consulting metallurgist on the Bureau of Mines staff for three years.

Thefts of explosives throughout the country, on coming to the attention of the Bureau of Mines men, are being reported to Director Manning. The number of thefts leads to the belief that more of this class of burglary is being indulged in on a more extended scale than is known generally.

A bill providing for the formulation of regulations for the handling of explosives has been reported favorably by the Committee on Mines and Mining and is now on the House calendar. The passage of this bill, Director Manning believes, will make possible the reduction of the amount of explosives finding their way into the hands of unauthorized persons, where serious damage may result under certain circumstances.

Negotiations looking to the raising of the English embargo on ferromanganese are in progress. Both the Committee on Raw Materials of the Council of National Defense and the Bureau of Foreign and Domestic Commerce have been active in the effort to secure a larger supply of this much needed alloy. It is understood to be the intention to have consignments made to the Department of Commerce for equitable distribution among purchasers. It had been hoped that this arrangement would be consummated before now but many unexpected delays have been encountered. It is believed, however, that the arrangement will be completed within a few days.

Without a protesting vote the Senate passed a bill to relieve the owners of mining claims, who have been mustered into the military or naval service of the United States, from performing assessment work on their claims during the term of their service. Several similar bills have been introduced in the House. The enactment of a law to the end sought by these bills is practically assured.

Confronted, as is the country, with a serious situation with respect to tin, Van. H. Manning, director of the Bureau of Mines, has suggested to the Council of National Defense that a separate committee be named to lend its assistance to the effort to better existing conditions.

As a means of increasing the efficiency of the Bureau of Mines' organization, the explosives laboratory has been placed under the direction of a chief chemist. This laboratory has been under the direction of the mining division.

Bitter criticism of the Council of National Defense has been indulged in on each side of the capitol during the past week. The Senate went so far as to adopt an amendment to the appropriation for the Council directing that it obey the law which created it. While many refuse to believe that the Council has done more than to get results in an emergency, it is noticeable that the committee on raw materials and the coöperative committees in charge of subjects pertaining to mining have not been criticized. In fact those of the lawmakers who are familiar with the work which has been done by this section of the Council speak in the highest terms of the manner in which it is being conducted. Many expressed the hope that new government departments be created to take over the work which the Council is attempting to perform. It is pointed out that the departments could utilize the services of such men as Bernard Baruch and Francis S. Peabody more effectively than can the Council because the latter organization has not the authority to put into effect its recommendations. From the attitude of the legislative branch, it is apparent that sufficient authority to make possible the best results is not likely to be granted.

In order to obtain sufficient laboratory room in which to conduct the rapidly increasing number of experiments being assigned to it, the Bureau of Mines plans to take over one of the laboratory buildings at the American University, located on the outskirts of Washington.

Another powerful committee has been added to the Council of National Defense. To coöperate with the committee on raw materials, a sub-committee headed by John D. Ryan, the president of the Anaconda Copper Co., has been named. The members of the committee are Murray Guggenheim, of M. Guggenheim's Sons of New York; R. L. Agassiz, president of the Calumet and Hecla Mining Co.; Charles McNeil, president of the Utah Copper Co.; James McClean, vice president of the Phelps Dodge Co. and W. A. Clark, president of the United Verde Copper Co. This committee was selected only after the most mature consideration. It is realized that on this committee will fall some of the most exacting duties, owing to the importance of copper in the waging of the war. An effort was made to have this as one of the first coöperative committees named but considerable time was lost in persuading the men desired for the committee to undertake the responsibility and the giving of a considerable portion of their time to it.

Important assistance is being given the national defense committees by the Bureau of Mines. The fact that Van. H. Manning, the director, was made an ex-officio member of each of the committees having to do with a mining subject has made it possible for the Bureau to lend ready assistance and to point out many of the problems needing immediate attention.

Personals

W. deL. Benedict has returned to New York from a business trip to California.

Charles Mills, of the Inspiration Copper Co., has been elected president of the Greene-Cananea Copper Co.

E. A. Cleveland, Vancouver, B. C., is consulting engineer for the Surf Inlet mines, at Princess Royal Island.

C. A. Botsford has become superintendent of the mines of the Caribel Mining and Milling Co., Red River, N. M.

R. B. Hoffman has just returned from Russia and passed through New York on May 14, en route to California.

L. D. Huntoon has been in Albany as expert witness in a suit about a milling operation connected with a New York mine.

G. R. De Beque has been commissioned in the Engineer Officers' Reserve Corps, and has gone to Fort Riley, Kan., for training.

J. R. Buchanan has gone to Fierro, N. M., to take charge of the mining operations of the Hanover Bessemer Iron and Copper Co.

James A. Farrell, president of the United States Steel Corporation, was leading speaker at a patriotic rally held recently in Greenville, Pa.

George E. Farish, well known in connection with Porcupine gold mining enterprises, has been appointed manager of the National Leasing Co. of Nevada.

W. H. Leonard, president of the Denver Rock Drill Co., of Denver, has organized and been elected captain of Troop E, First Regiment Colorado Cavalry.

Francis S. Schimerka has been appointed research engineer for the milling department of the Arizona Copper Co., Ltd., at Clifton and Morenci, Ariz.

Will H. Coghill has been appointed consulting metallurgist in the coöperative work of the Oregon Bureau of Mines and Geology, and the U. S. Bureau of Mines.

A. H. Brown, formerly manager for the Dome Lake company, at Porcupine, Ont., will go to Cobalt to unwater, examine and report upon the Green-Meehan mine.

Robert F. McElvenney has been appointed superintendent of the Garfield Smelting Co., Garfield, Utah, vice W. D. Leonard, who has been transferred to Colorado.

Julian Kennedy, consulting engineer, Bessemer Building, Pittsburgh, has been appointed a member of the state committee of public safety by Governor Brumbaugh of Pennsylvania.

S. F. Shaw, superintendent of the Tiro General mine of the American Smelting & Refining Co., is in charge of reopening the Panaco mine, near Moriciliva, Coahuila, Mexico, for the same company.

Paul E. Morse, superintendent of field construction for the Yuba Manufacturing Co., of Marysville and Benicia, Calif., has gone to Breckenridge, Colo., to superintend construction of a gold-placer dredge.

W. D. Leonard, superintendent of the Garfield, Utah, smeltery of the American Smelting and Refining Co., has been appointed assistant to General Manager L. G. Eakins of the Colorado department and will hereafter make his headquarters at Denver.

M. H. Kuryla, who has been connected with the Broadwater mill at Park City, Utah, for more than a year past, has gone to Silverton, Colorado in the interest of the United States Smelting people. R. E. Adams has been appointed to fill the vacancy at the Broadwater.

John Muir, superintendent of the Stowell mine since its purchase by the Mammoth Copper Co., at Kennett, Calif., has been transferred by the U. S. Smelting Co. to Miami, Okla., to take charge of exploration work. John Rathbone succeeds Mr. Muir at the Stowell.

George W. Goethals, announces his association with Charles C. Jamieson, Robert E. Graham, George H. Houston, John C. Jay, Jr., and George M. Wells, consulting engineers, 40 Wall St., New York. The name of the company will be Goethals, Jamieson, Houston & Jay, Inc.

Capt. Percy E. Barbour, managing editor of the "Journal," has resigned to accept the appointment of Deputy Superintendent, Department of State Police, with headquarters at Albany. Capt. Barbour, who has been 1st Lieutenant, 22nd Regiment, New York Engineers, has been commissioned a captain in the same corps.

R. L. Wahle, engineer for the Inland Steel Co. (Crosby), Kenneth Urquhart, engineer for the Quinn Mining Co. (Ironton), Robert Kerr, engineer for the Roger Brown Ore Co. (Crosby), and Guy Gunderson, chemist for the Inland Steel Co. (Crosby), have left for Fort Snelling to receive 3 months' training with the engineering corps.

Boris V. Constantinov, mechanical engineer, 29 Broadway, New York City, for about nine years in the engineering department of the Crane Company at Bridgeport, Conn., and who has established himself in the business as a representative of American companies to distribute products in Russia, plans shortly to visit Russia, where he has a brother in charge of the Russian end of the business.

Henry Bruere, who resigned as City Chamberlain May 1, 1916, in order to accept a vice-presidency in the American Metal Co., left New York on May 10 for Mexico on an unknown mission. It is now announced that he has gone to Mexico at the request of the Carranza Government to act as efficiency expert in reorganizing the Government departments and putting them on a sound business basis. The American Metal Co. has holdings in Mexico, among them certain mines in the State of Chihuahua, but the company, it was explained, has no interest in the work of Mr. Bruere, who is entirely at the service of the Mexican Government.

Obituary

Arthur M. Day, metallurgist at the International smeltery at Tooele, Utah, died at his home in Salt Lake City on the 1st inst., at the age of 52 years.

William A. Farish died at Los Angeles, Calif., on May 4, after returning from a mining trip to Arizona. He was well known as a pioneer mining man of California, and was for years associated with the late Senator George Hearst. He was at one time active in the Black Hills, South Dakota, assisting Senator Hearst in the forming of the Homestake consolidation.

Societies

Mining and Metallurgical Society of America held its monthly meeting on Apr. 19, at the Engineers' Club, the regular meeting being preceded by an informal dinner.

Institute of Metals held a general meeting at London, May 3, when a lecture on "Researches Made Possible by the Autographic Road-Extension Optical Indicator" was delivered by W. E. Dalby, F. R. S.

International Mining Convention was held at Nelson, B. C., May 17 to 19, 1917. The Columbia section of the American Institute of Mining Engineers and the local branch of the Canadian Mining Institute, also held meetings on these dates in connection with the International Convention. P. N. Moore, president of the American Institute, and Bradley Stoughton, its secretary, attended the convention.

The Franklin Institute, Philadelphia, presented the Franklin medal to his excellency Chevalier Van Rappard, of the Netherlands government for Hendrik Antoon Lorentz, Ph. D., F. R. S., president of the Royal Academy of Sciences, Amsterdam, at a meeting May 16. David Watson Taylor, D. Eng., chief constructor, chief of bureau of construction and repair, United States Navy, also received the Franklin medal. Following the presentation of medals, Mr. Taylor gave an address on "The Science of Naval Architecture."

Trade Catalogs

Air Lift Pumping System. Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill. Bulletin 71-C. Pp. 36; 6 x 9 in.; illustrated.

Deister-Overstrom Ore Concentrator. The Deister Concentrator Co., Fort Wayne, Ind. Bulletin. Pp. 26; 6 x 9 in.; illustrated.

Straight Line Air Compressors. Sullivan Machinery Co., 122 S. Michigan Ave., Chicago, Ill. Bulletin 75-B. Pp. 16; 6 x 9 in.; illustrated.

Crushing Rolls. Traylor Engineering & Mfg. Co., Allentown, Penn. Bulletin R-1. Pp. 38; 6 x 9 in.; illustrated. Contains many interesting charts for determining roll capacity.

Reducing Vibration and Noise. Armstrong Cork & Insulation Co., Pittsburgh, Penn. Booklet. Pp. 32; 5 x 7½ in.; illustrated. Describes the application of Nonpareil Cork to motors, fans, etc.

Industrial News

Gallagher Machinery Co. has moved its general offices to 103 West 2nd South St., Salt Lake City, Utah.

Indiana Steel Co. has completed the first of its new group of four blast furnaces at Gary, Ind., but has not yet blown it in.

J. L. Jacobs Co., engineers cost accountants and statisticians, have extended their organization by the addition of several experts to the staff of specialists.

Imperial Belting Co., Chicago, has found it necessary to double its plant capacity. Most of the new machinery for the additional four-story building is on the ground.

Stebbins Dry Concentrator Co. has shipped a 100-ton dry-concentrating plant to Barnes & Griver, Calixico, Calif. The plant was assembled and shipped within 15 days of the receipt of the order.

Snyder Electric Furnace Co. has closed contracts for the installation of furnaces with the West Steel Casting Co., Cleveland, Ohio; Pratt & Cady Co., Hartford, Conn.; Joyer Cridland Co., Dayton, Ohio; United Alloys-Steel Corporation, Canton, Ohio, and W. R. Hendersen Iron Wks., Shreveport, La.

Union Switch and Signal Co., Swissvale, Penn., is offering its munitions machinery for sale. The company has completed all its contracts for shells, and does not plan to continue in this line, chiefly because its main shop was destroyed by fire early in February, and the buildings formerly used for munition work have had to be taken over for its regular products. About half of the finishing machinery has been disposed of and the remainder, which the company desires to sell, includes the hydraulic apparatus.

Yuba Manufacturing Co., San Francisco, Calif., formerly known as the Yuba Construction Co., has been permitted by the state commissioner of corporations to sell $500,000 bonds to net not less than 94. Approximately $175,000 of the amount is to be applied to the purchase price of the recently acquired plant at Benicia and to provide extensions for the manufacture of tractors and farm implements. The remainder will be used to reduce current bills and increase working capital both for the Benicia and the Marysville plant, the latter being employed chiefly in the building of dredges.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Annealing Furnace—Furnace for Heating or Annealing. Alfred Smallwood, London, England, assignor to American Incandescent Heat Company, Portland, Me. (U. S. No. 1,226,266; May 15, 1917.)

Casting Mold. Arthur P. Scott, Chicago, Ill., assignor to Chile Exploration Company, New York, N. Y. (U. S. No. 1,226,123; May 15, 1917.)

Drill—Rock Drill. Daniel Shaw Waugh, Denver, Colo., assignor to The Denver Rock Drill Manufacturing Company, Denver, Colo. (U. S. No. 1,225,898; May 15, 1917.)

Drilling—Rotary Drilling-Bit. Leroy L. Richard, Coalinga, Calif. (U. S. No. 1,226,377; May 15, 1917.)

Electric Furnace. Frank C. Schmitz, New York, N. Y. (U. S. No. 1,226,264; May 15, 1917.)

Electric Furnace and Method of Producing Molten Magnetite Therein. Arthur P. Scott, Chicago, Ill., assignor to Chile Exploration Company, New York, N. Y. (U. S. No. 1,226,122; May 15, 1917.)

Filtration—Apparatus for Separating Unfilterable Material from a Mixture of Filterable and Unfilterable Matter. Charles W. Merrill, Berkeley, Calif. (U. S. No. 1,226,103; May 15, 1917.)

Filtration—Process for Treating Semisolid Material in the Containers of Filter-Presses and Removing the Same Therefrom. Charles W. Merrill, Berkeley, Calif. (U. S. No. 1,226,104; May 15, 1917.)

Flotation—Ore-Flotation Apparatus. Herbert C. Colburn, Colorado Springs, and Ernest A. Colburn, Denver, Colo. (U. S. No. 1,226,063; May 15, 1917.)

Flotation—Process of Concentration and Separating Minerals by Flotation. Herbert E. T. Haultain, Toronto, Ontario, Canada. (U. S. No. 1,226,330; May 15, 1917.)

Grinding—Grinding-Ring for Attrition-Mills. William Van Nostrand, Dalton, N. Y. (U. S. No. 1,226,032; May 15, 1917.)

Grinding—Tube-Mill. Frank E. Marcy, Salt Lake City, Utah. (U. S. No. 1,226,555; May 15, 1917.)

Lamp—Acetylene-Lamp. Peter Mora, Clinton, Ind. (U. S. No. 1,226,237; May 15, 1917.)

Mining Apparatus. Trimble de Roodé, New York, N. Y. (U. S. No. 1,226,065; May 15, 1917.)

Mining Method. Trimble de Roodé, New York, N. Y. (U. S. No. 1,225,784; May 15, 1917.)

Mine Timbering—Set for Timbering Mines. Homer M. Barber, Goldfield, Nev. (U. S. No. 1,226,444; May 15, 1917.)

Soldering—Aluminum-Soldering Flux. Hugh V. Burt, Rock Island, Ill. (U. S. No. 1,225,764; May 15, 1917.)

Editorial Correspondence

SAN FRANCISCO—May 16

Stealing of Dynamite from Cerro Gordo mine has been quickly punished. Late in April, eight boxes of dynamite were stolen from the Cerro Gordo Mines Co.'s powder storage house at Keeler, Inyo County. Without waiting for Federal, state or county officials to act, the management immediately employed three San Francisco detectives and it was through their promptness and activity that the thieves were run down and the powder located before it could be got out of the county. The expenditure of money and diligence used by the company in the recovery of the powder was largely due to the present international situation. The men, on being arrested and jailed, claimed they took the powder to raise money to buy whiskey. One of them is an I. W. W. named William Whalen, another an American citizen of German birth, named Charles Kunz. These two were arrested within the county and the third, named Trinibenegas, a Mexican, was arrested at Hanford. The Cerro Gordo powder house is situated about 1½ miles out of Keeler, convenient to the aërial tramway, and it has not heretofore been deemed necessary to keep a constant guard at the powder house. The company is now installing a searchlight that will be of service in guarding property in the neighborhood. It is probable that other isolated mines, particularly in southern California, will adopt similar precautionary measures.

Crude Oil Prices Advanced 5c per bbl. at the well on all grades. This advance by the Standard Oil Co. applies to all fields and will be effective May 11. In Kern River, Midway-Sunset, Lost Hills-Belridge, McKittrick, Coalinga the prices will be for 14 to 17.9 gravity, 78c. per bbl.; 18 to 18.9 gravity, 79c.; for each full degree above 18 and to include 24.9 gravity, 1c. per bbl. additional; 25 to 25.9 gravity, 87c. and an additional 2c. per bbl. for each degree above 25 to include 36.9; for oil of 37 to 37.9 the price will be $1.12 with an additional 3c. per bbl. for each degree above. The price in Ventura fields will range from 87c. per bbl. for oil of 25 degrees to $1.12 for 37 to 37.9 gravity and 3c. additional per bbl. for each degree above. Whittier-Fullerton field prices will range from 78c. for 16 to 17.9 gravity to $1.12 for 37 to 37.9 and 3c. additional per bbl. for each degree above. This announcement was made on May 10 and has attracted various comment as to the reason for the advance over the prices which were established in November, 1916. The most probable answer is that the marketing and refining companies need oil and the producer can not afford to increase production in the face of the high cost of drilling machinery and materials without prospective remuneration. The demand is and has been for several months in advance of production. The large marketing and refining companies are rushing development of their own wells and no doubt the independent producers will increase their development and production, but many of them will be compelled to practice rigid economy in the use of additional materials not only because of the increased cost but also for reason that delivery is slow. Many companies will make use of old machinery. Sixteen new wells were started in the first week in May and 11 of these were by the large companies, some of whom are abandoning unprofitable wells and installing the machinery at the new wells. The cost of drilling today is 75 to 100% greater than a year ago.

BUTTE—May 16

Southwestern Part of Butte District is developing rapidly and the great possibilities ahead there are beginning to attract the attention of mining men throughout Montana. The Anaconda Copper Mining Co., which already has extensive interests, is securing options on additional properties and is pushing the new work it has mapped out in this section. The Davis-Daly and Butte-Detroit companies, with other interests connected with both of these companies, are carrying on systematic development in their extensive holdings. The Clark interests also have plans for further development of their properties in the district, while numerous smaller companies are at work sinking shafts or getting ready to open their claims. The strike made by the Anaconda company in the crosscut that it has run from the 1800-ft. level of the Original mine to the Emma is developing into one of the most valuable bodies of zinc ore lately opened in the Butte district. Owners of the adjoining properties have been watching closely these developments for upon this showing to a great extent depends their prospects at depth. The crosscut is now being carried on south with the expectation of encountering, within 30 days, the big vein of the Black Chief, of which the vein recently encountered is supposed to be a shoot. The Anaconda development work in this section of the district now includes the continuation of the crosscut from the Original mine which has been carried to a point 800 ft. south of the Emma shaft, the raising from this crosscut to connect with the Emma shaft on the 800-ft. level, the sinking of the Bonanza shaft to the 1000-ft. level and the running of a crosscut from there to connect with the Emma and also crosscutting the Bonanza and other claims in that group. The crosscutting by Butte-Detroit company to the Ophir vein on the 1000-ft. level is making steady progress. The Ophir is within a few hundred feet of the point where the recent strike was made by the Anaconda company and it is in close proximity also to the Bonanza group of claims. At the Nettie mine which lies still farther west, Anaconda is taking out 170 to 180 tons per day that runs high both in zinc and silver. The Bonanza shaft, started Feb. 1, is now down 495 ft. and will be continued to the 1000-ft. level. Anaconda has also started to reopen the old West Nettie which adjoins the Nettie mine. The Davis-Daly company has started work at the Hibernia shaft which is 800 ft. from the Nettie shaft and is drained by the Nettie. A hoisting plant is being installed good for a depth of 1000 ft.; the old shaft has a depth of 400 ft. W. L. Creden has started development on the Brittania mine which is close to the Bonanza shaft of the Anaconda and has a 500-ft. shaft.

DENVER—May 18

"Highgrading" seems irrepressible. Cripple Creek mines have provided a supply of ore for a highly organized band of thieves who are being apprehended throughout the West. Miners, assayers and prominent business men have been recently arrested as participants in a scheme that has thrived for two or three years past whereby specimen ore has been shipped to Cheyenne, Wyo., for reduction, the bullion then going to San Francisco and being disposed of to the mint.

SALT LAKE CITY—May 18

Dry Canyon Mines in Tooele County are ready for the shipping season, after a winter of unusually heavy snows, given over largely to development work. At present the Kearsarge is making shipments, having completed the lower tunnel, as is also the Thad Stevens. The Hidden Treasure has been the heaviest shipper from this section, and is expected to maintain its record. Ore is accumulated at the Mono and at the Dry Canyon Consolidated. Work is being done at the Utah Queen, which expects to have ore in the market in about a month. The Wandering Jew, the Fourth of July and the Commodore will start work soon.

WALLACE, IDAHO—May 15

Tonnage in Pine Creek Mines has been investigated for the Oregon-Washington Railroad and Navigation Co., by Albert Burch, a mining engineer of note, formerly manager of the Bunker Hill & Sullivan. Upon his report will probably depend the decision of the railroad company on the question of building a branch up Pine Creek. The Pine Creek Mines Association a few weeks ago submitted figures to the officers of the railroad company, showing the amount of ore in sight and other statistics bearing on tonnage, and if these figures are approximately verified by Mr. Burch it is believed the construction of the branch will soon begin. If the railroad company turns down the proposition, several of the mining companies are planning to overcome the transport difficulty by a tramway to Sweeny station, which is in Northern Pacific territory and would therefore give them the advantage of railroad competition. At this time no ore is being moved from Pine Creek on account of the bad condition of the wagon road and the high water, which has carried out bridges.

Net Earnings of Cœur d'Alene Mines for 1916 have been filed with the county assessor. It is interesting to note that the Hercules shows the highest net return, with Interstate-Callahan second and the Hecla third. The gross value of ores extracted in 1916 was $32,466,115, or about 33¼% greater than in 1915, and the net profits were $12,114,465 as against $9,794,632 in 1915. The gross and net figures for the Cœur d'Alene companies in 1916 follow, the net figures being in parenthesis: Hercules, $7,278,258 ($2,931,136); Interstate-Callahan, $3,983,521 ($2,481,536); Hecla, $3,281,135 ($1,681,059); Bunker Hill & Sullivan, $6,253,048 ($1,310,971); Caledonia, $1,769,669 ($1,154,762); Federal: Morning mine, $3,621,557 ($1,006.791): Mace mine, $750,367 ($163,093); Wardner mine, $696,029 ($95,494); Green Hill Cleveland, $1,851,742 ($401,826); Tamarack & Custer, $1,013,779 ($338,746); Success, $702,901 ($221,328); Ontario, $392,078 ($162,182); Hunter, $815,779 ($161,361); Black Hawk, $39,385 ($2,852); Wyoming, $12,680 ($1322). Roughly stated the gross value of the mineral product in 1916 and the average prices of silver and lead increased at about the same ratio, while the price of spelter was a little less than in 1915. The net profits, however, did not increase in the same proportion, due to increased wages and the advance in the price of explosives and other supplies that enter into the mining operations. Unfortunately the reports on tons of ore produced are not uniform, some of the companies reporting tons of ore as it comes from the mine while others report shipping product. Considering that one big producer, the Stewart, dropped out in 1916, and the Tamarack & Custer was idle during much of the year, it is probable that the actual tonnage produced was not greatly in excess of 1915, and that the increase in value is mainly due to high metal prices. It might be noted that the report of the Bunker Hill & Sullivan shows $517,784 taken from the 1916 earnings of the mine for new smeltery construction.

MORENCI, ARIZ.—May 18

Plan of Holding Employees' Conferences has now been adopted by the Arizona Copper Co. At the initial meeting, held on May 14, W. H. Scott, foreman of the company's Coronado mine, made an interesting address on the Coronado slicing system, an exposition of the principles of which had been presented in Peter B. Scotland's article in the "Journal's" Mining Number of Apr. 6. The audience, which included a delegation of students and professors from the University of Minnesota, as well as Arizona copper employees, showed much interest in the talk. It is probable that conferences will be held biweekly so as not to conflict with the Phelps-Dodge conferences, which will also be held every other week.

JEROME, ARIZ.—May 17

United Verde Extension's Haulage Tunnel is to be one of the important outlets for ore of the Jerome district. It is to be completed about the time the smeltery is ready for operation, a contract having been awarded to the Potter Construction Co. for a tunnel 13,500 ft. long, about 2⅝ miles, to connect with the 1300 level of the famous property. The bore will be large enough to accommodate 30-ton ore cars, with provision for the drainage flow, which will be of immense advantage to the Jerome Verde, Dundee and other neighboring properties. It is understood that a share in the construction cost of $500,000 will be borne by these neighbors, which will gain also the large advantage of easy development at depth through the great bore. Construction is to be complete by June 15, 1918, and the work will be under direct charge of Daniel J. O'Rourke, for years with the Sullivan Machinery Co. No fear is felt that any unusual conditions will be encountered; the work as platted will pass through diorite, quartz porphyry and limestone. There is ample dumping ground for waste at the portal.

NOGALES, ARIZ.—May 16

Santa Cruz County is active; although it is one of the smallest counties in Arizona, this spring, there are four mills in operation or under construction using the flotation process. The oldest of these mills is the 100-ton plant of the Duquesne Mining and Reduction Co., flotation having overcome the difficulties previously experienced in concentrating these ores containing a large amount of garnet. The ores contain silver, lead, copper and zinc. Lessees have lately been making money shipping high-grade ores direct to the smelting plant. The new mill on the Three R mine, about 15 mi. northeast of Nogales, has a capacity of 150 tons per day; this well-known mine is now operated by the Harrison Brothers, of San Antonio, Tex., formerly large operators in Mexico; the ore is copper sulphide occurring in a fracture zone of alaskite. About three miles north of Nogales, the Lower California Metals Co. is completing its flotation mill which will handle custom ores as well as the low-grade ores from the Pilares and Los Charcos mines in northern Sonora, owned by the Sociedad Anonima de Metales controlled by the same interests. These mills will secure their power from the new line of the Arizona Gas and Electric Co., of Nogales, which has in operation two 250-hp. oil engines of the Seymour & McIntosh type. The added power facilities are stimulating development in other properties, and the power installation may be doubled before the year is out. The fourth mill is that of the Montana Mines Co., in the Oro Blanco district, about 30

miles west of Nogales. The mill is rated at 150 tons and is expected to be in operation by June 1. Three kinds of concentrates are to be made, the ore being complex sulphides of silver, copper, lead and zinc. The mill will use 10 Wilfley tables, as well as flotation machines, for concentrating. Grinding will be done in a Marcy mill driven by a Diesel-type engine. This mill is within a stone's throw of the old mill which has stood on the property for years as a monument of failure. Within a radius of five miles of this mill, there are five other such monuments. These old mills gave an extraction of only about 60% and hence the possibilities of this district under present metal prices are considered excellent. The Montana Mines Co., with the aid of the county, is building a road to the mine at a cost of $27,000. A large hoist and compressor have been installed for the development work; the shaft is about 200 ft. deep.

JOPLIN, MO.—May 19

Permanent Metals Committee for co-operating with the Government Zinc Committee of the Council of National Defense was chosen by ballot of active members of the Southwest Missouri Mine Safety and Sanitation Association at Thursday's meeting. Those selected were H. I. Young, Carthage, manager of mines in this district for the American Zinc, Lead and Smelting Co.; C. A. Smith, Webb City, manager of Coahuila Lead and Zinc Co.; A. F. Carmean, Carthage, president of Carmean & Squires Mining Co.; Temple Chapman, Joplin, independent operator; Thomas F. Coyne, Webb City, independent operator. The committee also will include W. B. Shackelford, president of the association, who will be an ex officio member. It is the intention to have the committe get in close touch with all operators of this district and get accurate figures on mining costs, in order that Government requests for information along this line may be answered intelligently.

Miami Zinc Mines Co., a new Massachusetts corporation, has bought for $700,000 the mining leases and lands of O. J. McConnell, of Miami, Okla., one of the pioneers in the Oklahoma section of the district. The property sold includes the fee to the 200 acres of land on which the camp of Picher, Okla., and the big mines of the Eagle-Picher Lead Co. are situated; it also includes a first lease on 200 acres of the S. A. Kenoyer land at Tar River, Okla.; also a 200-acre lease on the L. L. Cardin land at Tar River, on which three mills now are operating; also about 500 acres of leases in various parts of the Oklahoma section. Mr. McConnell started development in the Oklahoma field only four years ago, and at that time there was no development north of Commerce. His mill on Tar River, now operated under the name of H. J. Cantrell, trustee, was the first plant in that section of the field. He was the active manager of his properties, and after spending the summer on the St. Lawrence River, plans to get back into the mining game here.

HOUGHTON, MICH.—May 17

Success of Storage-Battery Locomotive for haulage on the 16th level of Calumet & Hecla's No. 15 shaft, Osceola lode, has induced the company to place an order for 32 locomotives of practically the same type as the test locomotive. They will have a 6000-lb. chassis, 1300-lb. starting draw-bar pull and 1000-lb. running draw-bar pull. They will be of the single-truck type with single motor and will operate on 40-in. tracks. Current will be supplied from 48 MV-13 iron-clad Exide cells, with the exception of one locomotive, which will be equipped with 63 G-11 Edison cells (the same as the locomotive now in operation). Eleven of the 32 locomotives will be used on the Osceola lode of the Calumet & Hecla, while the other 21 will be distributed among the subsidiary companies, as follows: Nine at the Ahmeek mine, three at the Osceola Consolidated, North Kearsarge branch, and nine at the Isle Royale mine. It is worthy of note, however, that five trolley locomotives are being installed at the Allouez, another Calumet & Hecla subsidiary.

DULUTH, MINN.—May 18

Navigation Has Been Improved by the warm weather. Ice conditions have been obstructing navigation to an extent almost unprecedented on the Great Lakes, causing numerous accidents and seriously delaying ore movements to lower Lake ports. Five vessels are reported aground. The Saxona and Mitchell sank in a collision and the Vulcan has been fast in ice for more than a week. Approximately 80 boats are waiting to pass through the lock at the Soo. Under normal conditions, May 1, finds the ore movements in full swing while this season it has been delayed at least three weeks. Present indications are that last year's shipment of 66,657,000 tons of iron ore will not be exceeded, although if conditions had been normal the tonnage forwarded to lower Lake ports was expected to reach 70,000,000 tons.

TORONTO—May 18

Increased Wages Formally Demanded on May 15 by the Cobalt miners. Letters were forwarded to the managers enclosing the scale—equal to an increase of 50c. per day—and requesting them to meet committees of the men and endeavor to bring about an amicable settlement. They were given until May 31 to reply. It is expected that a royal commission will be appointed to investigate conditions in the hope of securing a satisfactory adjustment.

Minerals Separation has served notices on all companies operating in Cobalt, which are using flotation process, that such use, without permission and without paying royalties, constitutes an infringement of the company's rights. They have offered to settle on the basis of a certain percentage of the value of the silver in the mill heads, but none of the Cobalt companies have shown any desire to take advantage of this offer. No doubt litigation somewhat similar to that in the United States will take place, and it is understood that the defendant company has already been selected.

Prospecting Curtailed, this year, owing mainly to the war. There is a great decrease in the number of prospectors going into the mining regions of northern Ontario. Many of the former prospectors have enlisted, and those remaining have little inducement to take up the work, as owing to unsettled financial conditions, few capitalists will be in the market for claims. There is some activity in the Matachewan district where much staking was done during the fall and winter, and prospectors are going in to do assessment work. The promise of improved transport facilities in the Gowganda area has stimulated somewhat the development work in that section.

JOHANNESBURG—Apr. 19

Centralization of Rand Mining is further extended by the Central Mining and Investment Corporation taking the control of the Neumann group of mines. This caused little or no surprise on the Rand. For some time past the two groups have worked hand in hand, and it was anticipated that ultimately the control of the Neumann mines would pass into the hands of the Central Mining group. "Corner House" has also taken control of the East Rand Proprietary Mines, and this with the absorption of the Robinson control by the Barnato group, makes three separate groups less on the Rand. There used to be 10 different mining groups controlling the working of the different gold mines on the Rand, but these have now been practically reduced to five. It is, therefore, evident that should it ever appear expedient or necessary, the way is gradually being simplified for the Rand Mines, Ltd., to follow the Kimberley example, and take over the working of all the gold mines on the Rand. Had there been any well defined advantage in this step, no doubt it would have happened long ago, but the manifest difference in the advantage of out-and-out amalgamation and control of gold and diamond mining, may be the explanation why such change has not been made. However, there is still an impression on the Rand that ultimately Rand Mines, Ltd., will be controlling the operations of all the best mines on the Rand.

The Mining News

ALASKA

COPPER SHIPMENTS from Alaska in April as reported by Department of Commerce amounted to 10,585,518 lb.

ALASKA TREADWELL (Treadwell)—In March crushed 37,838 tons yielding $79,386 or $2.12 per ton; operating expenses, $46,445; operating profit, $32,941; construction expense, $16,641; sundry income, $11,839; net profit for month, $28,138.

ALASKA MEXICAN (Treadwell)—Crushed in March 6685 tons yielding $11770 or $1.78 per ton; operating expenses, $10,677; operating profit, $1093; construction expense, $4309; loss, $3216. Sundry income, $5063. Mexican mill crushed also in March 8120 tons for Alaska United.

ALASKA UNITED (Treadwell)—In March, the 700 Claim mill crushed 24,675 tons yielding $52,926 or $2.17 per ton; operating expenses were $68,223; operating loss, $15,297; construction expense, $9708; net loss, $25,005; sundry income, $2041. Ready Bullion mine produced 32,025 tons yielding $62,443 or $1.97 per ton; operating expenses, $48,253; operating profit, $14,190; construction expenses, $5224; net profit, $8966; sundry income, $2041.

ARIZONA

Cochise County

CALUMET & ARIZONA (Warren)—Sinking started on the five-compartment shaft at Bakerville. It is to go to 2000 ft. and is intended to relieve the Junction shaft.

SHATTUCK ARIZONA (Bisbee)—In April, developed new lens of 7% copper ore, 40 x 90 ft., between 600 and 700 levels; about 70 ft. thick. Preliminary surveys made for new lead concentrator; lead ore shipments to El Paso amount to about 150 tons per week.

DENN ARIZONA (Bisbee)—Surface machinery is being put in shape for resumption after idleness of over six years owing to heavy flow of water opened on 1600 level. Water rose later to 1250 level but pumping at Calumet & Arizona's Junction shaft has drained much of the Denn territory. Superintendent Houle of the Shattuck Arizona, is in charge of the preliminary work.

COPPER QUEEN (Bisbee)—With the mining of the Sacramento Hill concentrating ore, a second stage in the history of this district will have been reached. Approximately 12,000,000 tons are understood to have been developed in this disseminated deposit and the test mill has indicated the metallurgical method for a large reduction plant in the district. Mining near the surface at least, is to be done by steam shovel.

Gila County

MIAMI (Miami)—Flotation results in April from 129,905 tons of feed averaging 1.161% copper were 1674 tons of concentrates averaging 42.475%; copper in tails 0.622%; largest flotation tonnage yet handled. Company has subscribed for $500,000 of the Liberty bonds.

Mohave County

NEW 150-TON MILL for custom ore is planned at Chloride by A. G. Stearns. Proposed site is on east side of Silver Hill, near railroad track.

GLADSTONE (Chloride)—Unwatered and mining operations will be proceeded with under direction of F. C. Smith, general manager of the Hidden Treasure.

MINNESOTA-CONNOR (Chloride)—New York men will begin development on this property, formerly noted for its high-grade silver ore. New mining equipment will be necessary. P. S. Virgin temporarily in charge.

NEW MOHAWK MINING CO. (Chloride)—On the old Puzzle mine a second shaft has been started to connect with old winze, in which high-grade silver ore was recently found; connection will be made at 100 ft. Hoist lately purchased for first shaft and another will be secured for shaft just started. J. J. Robertson, general manager.

TOM REED (Oatman)—For fiscal year ended Apr. 1 report shows 46,170 tons of ore milled having gross value of $502,358; average extraction, 97.61%. Over 9000 ft. of development done and ore reserves increased from 6000 to 54,000 tons. Old stamp mill superseded by practically new milling plant of 300 tons capacity. A 4000-ft. Leschen tramway being installed to bring ore to mill from new Aztec workings, where vein was opened on 400- and 535-ft. levels, for total length of 1100 ft., with milling ore across average width of 6 ft. and lower-grade ore for additional width of 25 ft. The old workings are being opened up at the 1400-ft. level, where extensive development work is now being done; practically all ore mined to date has been above 1175-ft. level of the old workings. E. M. Rabb, superintendent.

Pima County

AJO CORNELIA (Ajo)—First diamond-drill hole down 750 ft., will go to 1000 ft. Leasers preparing shipment of surface ore.

Yavapai County

GADSDEN (Jerome)—Shaft down 330 ft.; still in limestone.

JEROME VERDE (Jerome)—Drill hole being driven to intersect ore, 100 ft. from where it was cut by previous hole, now in about 450 ft.

CALIFORNIA

Amador County

ARGONAUT (Jackson)—Incline shaft has reached 4667-ft. point; will be continued 118 ft. deeper, making the total incline depth 4785 ft., or a vertical depth of 4143 ft. New battery of stamps operating in new mill; installation of 40 stamps from old mill expected to be completed in about 90 days.

Calaveras County

ROYAL (Hodson)—Reported that F. W. Page, manager, and H. P. Brett are preparing to reopen mine. Formerly large producer.

Shasta County

ARPS COPPER CO. (Copper City)—Preparing to install hoist, compressor and machine drills; 20 men now employed. Will be increased after installations. W. W. Henry, Jr., general manager.

EL ORO DREDGING CO. (Redding)—Reported that prospecting on Menzel ranch, across Sacramento River opposite Redding, has disclosed profitable gold-bearing gravel and that company will install dredge.

AFTERTHOUGHT (Ingot) — Ground being graded for construction of flotation plant; 20 teams employed; 150 men employed in mining and construction work. Twenty cottages and large office building being built.

Sierra County

MEXICAN (Downieville)—Milling resumed on ore mined during winter. C. J. York, owner and operator.

GOLD POINT (Downieville)—Two shifts employed mining and milling free-gold ore. Sidney C. Love in charge.

WHITE BEAR (Downieville)—Prospecting resumed for northern extension of this famous gravel channel. Under option to John Costa of Downieville.

NORTH FORK (Forest City)—Former rich gravel producer on Alleghany-Downieville serpentine belt, after much expensive development work, struck quartz vein yielding specimen ore at 265 ft. in incline shaft. George F. Stone, manager.

Siskiyou County

ORO GRANDE MINING CO. (Callahan)—Incorporated to merge four important mining properties. The Oro Grande, formerly the McKeen, is an old producer by stamp crushing and amalgamation; flotation is to be installed, starting with a 100-ton plant. James R. McKinnie, formerly of Cripple Creek, Colo., is president; Theodore Craig, general superintendent; James McKeen, millman. New orebody being developed in the Trail Creek mine under superintendency of George Foster. R. J. Young, in charge of the Kangaroo, is driving 1000-ft. tunnel to tap orebody at depth of 600 ft. The other property, the Sugar Creek mine, not being developed at present.

Trinity County

GOLD STANDARD CONSOLIDATED (Coffee)—This Oakland, Calif. company has optioned the J. R. Blair property on which high-grade ore has been disclosed. Lincoln Brodt, president. Development in charge of William Briggs.

Tuolumne County

CLIO (Jacksonville)—Reported that Robert Grauer of Oakland is preparing to reopen.

BUCHANAN CONSOLIDATED MINES CO. (Tuolumne)—Incorporated by F. M. Carter and Fay Chadbourne, of Oakland; T. R. Vincent, of Alameda; L. E. Carter, of San Francisco and C. W. Mitchell, of Pasadena. Mine will be reopened and developed at depth.

COLORADO

Boulder County

WILSON (Eldora)—This group on Woodlawn Heights being reopened.

CARIBOU (Cardinal)—Sinking of shaft to 1040-ft. level completed. Regular shipments being made. Extensive improvements planned for mill.

Montezuma County

ALLARD (Mancos)—New machinery will be installed. Oreshoot carrying copper and silver developed.

Park County

SNOWSTORM PLACER has been optioned by Tonopah Placers Co., of Breckenridge. Comprises acreage between town and rich ground hydraulicked for many years. Drills are now prospecting ground to determine its suitability for dredging.

San Juan County

GOLD KING (Gladstone)—Mill will resume soon. Development work continued all winter at mine and much ore blocked.

SUNNYSIDE (Eureka)—Reported that plans are completed for erection of 500-ton mill at this property recently sold to U. S. Smelting, Refining and Mining Exploration Co.

SUMMIT COPPER MINING CO. (Ironton)—Development and repair work carried on during winter. All workings in good shape and stopes on Koelker Tunnel level ready for production. Ore carries gold, silver and copper.

San Miguel County

ALTA (Telluride)—Experimenting with flotation; mill to be remodeled.

BLACK BEAR (Telluride)—Pump trouble at Blue Lake necessitated a curtailment of production temporarily.

APRIL SHIPMENTS of concentrates from Telluride district were as follows: Tomboy, 50 cars; Smuggler-Union and Black Bear, 40 cars; Liberty Bell, 12 cars; Inama & Perino Leasing Co., two cars; total, 104 cars.

Summit County

PUZZLE (Breckenridge)—Three feet of gold-silver-lead ore opened by lessees in Gold Dust ground from main tunnel level.

GOLD QUEEN (Kokomo)—Being developed by Mutual Co-Operative Mining Co. Two cars high-grade silver ore shipped recently.

ROYAL TIGER (Breckenridge)—Development work being done under direction of John A. Traylor Mining and Milling Machinery Co., of Salt Lake City.

PIONEER CONSOLIDATED (Breckenridge)—Mill making test runs after overhauling. Ore coming from Extension and Jumbo workings. Much old stope filling being drawn and new oreshoots being developed.

Teller County

SHOO FLY (Cripple Creek)—Small shipment of sylvanite ore assaying 49 oz. gold per ton made recently from 200-ft. level by lessees.

PORTLAND (Cripple Creek)—Three units of new Independence mill operating steadily. Entire five units to be in operation by end of May. Total capacity, 1250 tons daily.

ROOSEVELT TUNNEL advanced 171 ft. in April; heading in Little Edith claim on west side of Battle Mountain; flow between 8000 and 9000 gal. per min.

GRANITE (Cripple Creek)—Tramway from Dillon shaft to loading bins on Short Line tracks, near Victor, being installed. Shipments from this shaft now hauled by wagons.

MIDGET (Cripple Creek)—Sublessees of Backoff Leasing Co., operating Midget property, made rich surface strike on Bonanza King; first shipment made. Backoff Leasing Co. shipping milling grade ore from main shaft workings to Colorado City.

WAR EAGLE CONSOLIDATED (Cripple Creek)—Development is in progress from the War Eagle shaft. Lease granted on the Allen shaft, which will be retimbered and placed in working condition; new shaft house will be constructed and hoisting plant installed. Crosscut driven to cut Josephine vein at the bottom or 500-ft. level of Scott shaft; this will be continued to cut vein recently opened on 400-ft. level. Raise being made from 400-ft. level in the Happy Year property.

IDAHO

Bonner County

ARMSTEAD MINES, INC. (Spokane, Wash)—This company, which is developing the Keystone silver mine, at Blacktail, near Lake Pend Oreille, is installing new equipment, including storage-battery locomotives, 4000 ft. of 18-in. pipe for ventilation, and of 2-in. pipe for compressed air, Leyner drills, and other apparatus for driving the 1400-ft. tunnel a further distance of 2200 ft., where it will attain a depth of 1600 ft. in the Keystone claim. Company expects to complete concentrator by the time lower tunnel has been connected with the upper workings. Directors include several tobacco manufacturers; officers are Henry H. Armstead, president and manager; A. H. Burroughs and Karl Jungbluth, vice-presidents; H. D. Kingsbury, treasurer, and H. L. Brown, secretary; these with C. C. Dula and J. Peterson, comprise the directorate.

Shoshone County

INTERSTATE-CALLAHAN (Wallace)—Mined in first quarter 77,700 tons averaging 23.7% Zn, 2.5 oz. Ag, 6% Pb. Shipped 15,743 tons of ore and concentrates, of which 13,839 tons were zinc and 1634 were lead. Flotation installation expected to be completed in second quarter.

MICHIGAN

Copper

AHMEEK (Ahmeek)—Tonnage below average, probably due to lack of men. The new 800-kw. steam turbine at this mine is almost ready for test run.

MASS (Mass)—Daily tonnage about 1000 tons. Could easily use 150 more men at present. R. H. Peterson has succeeded E. R. Jones as superintendent.

SENECA (Calumet)—Overburden at site of proposed shaft found to be 10 ft. deep. Shaft will be sunk vertically about 1350 ft. and then on incline about 400 ft.

MOHAWK (Mohawk)—Erecting new machine shop, smith shop and hospital, and at the mill at Traverse City a steel tank of 100,000-gal. capacity on a 100-ft. tower.

WINONA (Winona)—Electric hoist at No. 4 shaft repaired; no time lost, as steam power was available. Drifting on 10th and 11th levels showing good grade of rock.

NEW ARCADIAN (Houghton)—Sending about 400 tons of rock to the Franklin mill daily. On 1500-ft. level 400 ft. of drifting has shown ore slightly above the average.

ALLOUEZ (Calumet)—The five trolley locomotives ordered some time ago are now on the ground, and as soon as motor-generator set is received they will go into commission.

ISLE ROYALE (Houghton)—Daily tonnage slightly over 3000 tons. Development slightly curtailed to use men in maintaining tonnage. Building modern change house at No. 6 shaft.

KEWEENAW (Mandan)—Improving its recovery with use of modern equipment for the one stamphead operating at old Phœnix mill; getting a little over 12 lb. of copper per ton of rock. The rock is soft and chalky in places, being easily milled; the richest is coming from the footwall.

CALUMET & HECLA (Calumet)—April production by Calumet & Hecla and subsidiaries was: C. & H., 6,855,514 lb.; Ahmeek, 2,473,495; Allouez, 771,253; Centennial, 125,403; Isle Royale, 1,282,242; La Salle, 247,311; Osceola, 1,516,569; Superior, 143,614; Tamarack, 478,519; White Pine, 453,261 lb.

MINNESOTA

Cuyuna Range

CROFT (Crosby)—Loading 40,000 tons from stockpile. Ships two grades of ore, bessemer and non-bessemer.

MAHNOMEN (Ironton)—Shipping manganiferous and iron ores. Two steam shovels working. Drainage shaft completed and now drifting under pit operations.

MISSOURI

Joplin District

ST. PAUL (Joplin)—Has resumed operation of Black Hawk mine at Spring City.

TALEQUAH (Miami, Okla.)—Drilling 45-acre lease half mile south of Quapaw, Okla.

LUCKY G. W. (Miami, Okla.)—Purchased Lucky Jew lease near Tar River and will develop.

ROANOKE (Commerce, Okla.)—New 350-ton mill in operation. E. M. Funkhauser, principal owner.

J. DILLON (Joplin)—With associates, has obtained lease on 360 acres, west of Miami, Okla., and will start drilling immediately.

HIRAM DIGGINS (Joplin)—Will build mill on site now being developed north of Chitwood. Two holes in rich ore. Hiram Diggins Chinn, manager.

BIG THREE (Miami, Okla.)—Constructing mill on lease near Quapaw, Okla. Mansfield, Mo. investors, including P. W. Jackson, principally interested.

ONAMENA (Webb City)—Moving No. 1 mill to new site on Boston-Duenweg lease in central part of town of Duenweg. Recent drilling shows ore at 210 ft.

NATIONAL ZINC AND LEAD (Joplin)—Moved No. 4 mill from south or Carterville to Slim Jim lease northwest of Picher, Okla.; transfer was completed in 38 days. Two shafts in ore at 148 ft.

F. R. COOK (Springfield, Mo.)—Has struck both zinc and thick oil on Hartley land, just south Baxter, Kan. Ore struck at 115 ft. and oil at 152 ft. Oil so thick further drilling impractical. May develop.

H. RAITINGER (Aurora)—With associates, will build mill on new site two miles southeast of Aurora, where unexpected body of ore was developed, by drilling, at 200 ft. Cuttings carried between 18 and 20% of blende.

PROVIDENCE (Galena, Kan.)—Mill rebuilt. Will install Arthur concentrator in lieu of slime tables; first ever used in this district; is centrifugal apparatus recently perfected by J. B. Arthur, Kansas City, Mo.

MONTANA

Beaverhead County

BOSTON & MONTANA DEVELOPMENT (Butte)—Company has doubled force at work on new railroad that is to run to its Elkhorn properties and further increase will be made soon. At the mine 40 men are at work.

Jefferson County

ECONOMY (East Helena)—The 300-ft. incline at this copper-gold-silver mine flooded owing to failure of power. Steam power will be superseded by electric. New milling equipment is contemplated. Rosenfield Bros., owners.

Lewis and Clark County

HELENA (Helena)—Two carloads shipped recently from shaft sinking. Shaft 260 ft. deep. Superintendent Cupples, in charge.

CARBON HILL (Helena)—Drifting on 300-ft. level. Silver ore being taken out. Superintendent is Frank Ernest.

ROCK ROSE (Helena)—Four feet of galena encountered on 150-ft. level in this Grass Valley mine. L. S. Ropes, consulting engineer.

THOMAS CRUSE DEVELOPING CO. (Helena)—Opened body of high-grade shipping ore 600 ft. east of shaft on 600-ft. level. Edward Ferrell, superintendent. Gasoline power used.

JULIA (Helena)—This mine has installed new 50-hp. boiler and engine; sinking of 200-ft. incline shaft will be resumed soon. Eleven cars of gold-silver-lead ore have been shipped. M. L. Higgins, superintendent.

BARNES KING DEVELOPMENT (Butte)—Profits in first quarter were $100,518; cash on hand Apr. 1 was $119,681. Of total receipts of $232,100, North Moccasin mine in Fergus County produced $67,137; Piegan-Gloster, $73,565, and Shannon, $83,243. Shannon shaft sunk 100 ft. to open up 500-ft. level; was in payable ore

65 ft. In April, Shannon produced 2853 tons tons assaying 14.60; Gloster, 2100 tons assaying $17.17; at the North Moccasin, 1664 tons yielded $19,500 in buillion. Practically no work yet done on Boyer mine; under option till 1918.

CRUSE CONSOLIDATED (Helena)—Two-compartment shaft at this property in the Grass Valley section is nearing 200-ft. level. Ore, lead and iron sulphides. Mine has 40-hp. steam plant. Martin Backstrom, superintendent.

Silver Bow County

TUOLUMNE (Butte)—Crosscut on 700-ft. level of Butte Main Range mine is apparently entering vein, supposed to be Rory O'Moore or extension of the Torrid vein of the Tropic mine. On 500 level, crosscut to the Spread Delight vein is in about 530 ft., with about 100 ft. yet to go; raise being driven from 700 level to intersect the crosscut where it enters the Spread Delight. The double-drum hoist ordered from the Nordberg company is to be ready about Oct. 1, when shaft is expected to be 1000 ft. deep. Tuolumne mine still closed though free from gas from High Ore fire; Anaconda has run water lines through mine to the Modoc fire zone.

NEVADA

Esmeralda County

JUMBO JUNIOR (Goldfield)—Being developed from 880-ft. level of Velvet shaft. Carload of ore recently shipped. Secured lease for one year on block of Kewanas ground, 600 x 150 ft.

CRACKERJACK (Goldfield)—Cornish-type pump erected at main shaft; workings unwatered to 320-ft. level where east crosscut is being driven to encounter vein exposed on 120-ft. level.

MERGER MINES CO. (Goldfield)—For past year development entirely through Grizzly Bear shaft. Now plan to explore shale and contact zone on 1350-ft. and 1750-ft. levels of main Merger shaft.

RED HILLS FLORENCE (Goldfield)—Property now equipped with 50-ft. headframe and double-drum hoist; compressor ordered. Shaft repaired to depth of 550 ft. and development under way on 500-ft. level.

SPEARHEAD (Goldfield)—On 400-ft. level now crosscutting east from north drift to encounter vein worked in old Wheeler lease. On 910-ft. level silicified zone on contact about 20 ft. thick in which north and east drifts are beng run on low-grade quartz containing occasional bunches of shipping ore.

Mineral County

KENTUCK CONSOLIDATED (Sweetwater)—Erecting mill purchased from Denver Quartz Mill and Crusher Co. Treatment will include amalgamation and concentration.

B. B. TODD MINING (Reno)—Plans to resume shipping at early date. At annual meeting, May 15, elected following directors: L. E. Aubury, of San Francisco; H. F. Norcross, of Los Angeles; C. A. Bradley, of New York; W. M. Gardiner and R. B. Todd, of Reno.

Nye County

TONOPAH ORE PRODUCTION for week ended May 12 was 9468 tons, valued at $175,158, compared with 9604 tons for week previous. Producers were: Tonopah Belmont, 2958 tons; Tonopah Extension, 2380; Tonopah Mining, 2150; West End, 845; Jim Butler, 650; Rescue-Eula, 255; North Star, 55; Cash Boy, 55; miscellaneous leases, 120 tons.

MANHATTAN MUSTANG (Manhattan)—Strike of high-grade ore made by Train-Chase lease at depth of 200 ft. in Mustang Hill. Carries both free gold and sulphides.

WHITE CAPS (Manhattan)—Shaft has reached 45 ft. below fourth level. Overhauling of mill progressing and new roaster partly erected. Twenty men working on wagon road.

TONOPAH EXTENSION (Tonopah)—Installing steam-driven turbine and 400-kw. generator as auxiliary power unit. Primarily to avoid delays in sinking, through interruption of power service.

RESCUE-EULA (Tonopah)—During April, 940 tons ore mined; treated at West End mill for yield of $24.90 per ton. Net profit, $9000. On 1100-ft. level, now drifting east on vein in Maggie May claim.

ROUND MOUNTAIN (Round Mountain)—Quartz mill being run on low-grade ore from various large blocks to determine advisability of erecting much larger plant. Hydraulicking also in progress with improved equipment.

LOUISIANA CONSOLIDATED MINES CO. (Tonopah)—At Tybo property, 68 miles northeast from Tonopah, working crew of about 25 men. Of 10 Duplex 3½-ton trucks ordered, three are in commission making round trip to Tonopah with 3½-ton trailer every two days. Preparing shipment of ore sorted from old dumps.

Storey County

ANDES (Virginia)—Saved 109 cars of ore from 350 level, averaging $8.30 per ton.

JACKET (Gold Hill)—Saved 107 cars of ore from surface tunnel workings. Continued mill repairs.

ALPHA & EXCHEQUER (Virginia)—Saved three cars of ore from 200 level, averaging $48 per ton. Saved four cars from new stope, averaging $9.56 per ton.

MEXICAN (Virginia)—Mill crushed 12 tons from 2700 level, averaging $14.65; from Wedge dump 335 tons, averaging $6.05; from the Union 218 tons, sampling $20.97; from Sierra Nevada 90 tons, sampling $14.65. Two bars of bullion shipped.

CON. VIRGINIA (Virginia)—Southwest drift, 2700 level, advanced to the 192-ft. point; in ore for more than 120 ft. Drift follows hanging wall, with 11 ft. of ore exposed in face and quartz of unknown width to the west. Extracted 138 cars of ore from the 10-ft. advance, averaging $20 per ton, a substantial increase over previous week. From the second floor extracted 74 cars, averaging $12.46 per ton; practically same grade as last week.

NEW MEXICO

Grant County

McGHEE BROS. (Steins)—Shaft down 150 ft. is in zinc carbonate; may ship soon.

SANTA RITA DEVELOPMENT (Santa Rita)—Bornite opened on Ruddle claim; churn drilling progressing near Chino's Hearst pit. H. H. Loomis, manager.

LEO XIII MINING (Silver City)—Developing group of claims 1½ miles west of Sante Fe R.R. by crosscut tunnel to vein carrying copper, gold and silver. T. H. Finley, secretary.

BETHLEHEM COPPER (Steins)—New company, organized by J. E. Sund and associates, to develop 12 claims in western part of county; contract let to P. T. Evers of San Simon, Ariz., for churn drilling; ten 500-ft. holes contemplated.

OREGON

WESTERN REDUCTION CO. (11 Lumberman's Bldg., Portland)—Expects to begin production of ferromanganese and ferrosilicon, as well as other ferro alloys, by electric furnace during June. J. H. Haak, president.

Josephine County

CHROME ore has been discovered on Sexton Mountain, purchased for timber by Dr. J. J. Williams of Pacific Grove, Calif. Will be developed.

UNITED COPPER (Grants Pass)—Shipped first car of concentrates from new mill on Grave Creek. Some rich sulphide ore also being shipped to Tacoma smeltery.

R. J. ROWEN (Grants Pass)—Has acquired chrome claims near Oak Flat on Illinois River and will build motor-truck road 14 miles to connect with county road at Selma.

UTAH

Beaver County

PALOMA (Milford)—Shipped recently two cars lead-silver-copper ore.

MAJESTIC (Milford)—First car of ore shipped this season from company's Hoosier Boy property; ore lead-silver, from 700 level.

CROFF (Milford)—Strike of copper-silver-lead ore reported. Two cars ready for shipment. Property consists of five claims adjoining the Lincoln (old-time producer) and the Creole.

BEAVER LAKE DISTRICT, west of Milford, is active. The Copper Mountain recently shipped car of ore; Beaver Lake Metals is drifting on the 150 level to reach ground below oreshoot productive during past summer; Beaver Copper is doing development on the 200, and taking out some ore. Work being done at the Black Rock Copper, two miles west from the Copper Mountain.

Juab County

TINTIC SHIPMENTS for week ended May 11 were 230 cars, an unusually heavy week. Compares with 188 in week preceding.

CHIEF CONSOLIDATED (Eureka)—Has made further addition to its territory, acquiring ground of R. G. W. Mining Co. (five patented claims in the Tintic district).

EMPIRE MINES (Eureka)—Active development of 700 acres—acquired by the merging of a number of Tintic properties—has begun. Two drifts being driven in Lower Mammoth ground, one for the Black Jack, which will be opened 600 ft. below present deepest workings, and the other to the north in the Lower Mammoth in search of a possible extension of the Gem ore channel of the Centennial-Eureka. Carisa ground, the most-recently acquired, will be opened by drifting from the Iron Blossom on both the 1500 and 1900 levels. Lessees mining ore at Black Jack and Lower Mammoth will contribute toward expenses, and company has cash reserve, as well large amount of stock in treasury.

Salt Lake County

UTAH COPPER (Bingham)—More favorable weather has made possible increase in tonnage to 35,000 tons daily. Maximum, last autumn, was 40,000 tons per day.

CARDIFF (Salt Lake City)—Company, having had so much difficulty in getting ores to market, is stated to be considering putting on tractors of its own. These would take the ore from the company's bins at the mouth of South Fork in Big Cottonwood canyon to the sampler at Murray. Throughout winter, ores have been brought to South Fork from the mine—a distance of three miles—in bobsleds, and from there hauled by a second relay of bobsleds as far down the canyon as possible. There are about 1500 tons of Cardiff ores stacked along the canyon road.

WASHINGTON

Ferry County

GOLD DISCOVERY made by John H. Falconer on ranch of Jud Logsdon, ½ mile west of Danville. About 50 lb. of high-grade ore taken from 10-in. quartz stringer which runs into wide zone of iron-stained decomposed quartz.

F. H. & C. GOLD MINING CO. (Rockcut)—A 5-ft. oreshoot containing some high-grade silver ore found in 18-ft. vein; the richest of the ore will be shipped. Shaft 65 ft. deep. J. J. Hennessy, treasurer and manager.

WYOMING

Fremont County

AMERICAN FIREPROOFING AND MINING CO. (Lander)—Developing asbestos in serpenting dike about 400 ft. wide, traceable on surface for 3000 ft.; chrysotile fiber of good grade. A. E. Minium, manager.

CANADA

Ontario

ORE SHIPMENTS over Temiskaming & Northern Ontario Ry. in April, as reported by Arthur A. Cole, mining engineer, were: Silver ore from Cobalt: Alladin Cobalt, 95; Beaver, 32; Conagas, 44; Dominion Reduction Co., 349; Hudson Bay, 63; Kerr Lake, 22; LaRose, 72; McKinley-Darragh, 126; O'Brien, 86; Temiskaming, 68; total, 957 tons. Crude asbestos from South Porcupine: Slade & Forbes, 0.75 tons. Gold ore from South Porcupine: Tommy Burns mine, 22 tons. Nickel ore from Porquis Junction: Alexo mine, 373 tons.

SCHUMACHER (Schumacher) — Construction of 140-ton mill addition started.

BOSTON CREEK (Boston Creek)—High-grade vein, found on 200-ft. level, has been picked up at 400 ft.

TECK-HUGHES (Kirkland Lake)—April output was $6466, from 1336 tons of ore; average value, $4.84 per ton.

DOME (South Porcupine)—Milling 1000 tons per day; most of ore is coming from openpits and is of low grade.

NIPISSING (Cobalt)—During April mined ore estimated at $259,082 and shipped $517,719 in bullion from Nipissing and custom ore.

ELLIOTT-KIRKLAND (Kirkland Lake)—Crosscut at 125-ft. level has intercepted brecciated porphyry zone, carrying gold.

HOLLINGER RESERVE (Timmons)—Now being operated after idleness of several years. Has developed body of ore between the 400 and 500 levels.

PITTSBURGH LORRAIN (South Lorrain)—On this property, formerly the Currie, diamond drilling undertaken to test formation below old workings. Opened to 500 ft.

TASH-ORN (Tashota)—Main shaft down 115 ft.; drifting on 100-ft. level. Vein shows considerable free gold and wall rock on either side is good milling ore.

WRIGHT-HARGRAVES (Kirkland Lake)—Work stopped on account of delivery of defective compressor parts; will be resumed as soon as new machinery can be delivered.

CONIAGAS (Cobalt)—Installing second flotation unit, which will bring total tonnage treated to 500 tons a day. Old tailings will be retreated as well as the run-of-mine ore.

BEAVER CONSOLIDATED (Cobalt)—Considerable high-grade ore being developed at 400-ft. level. At the 600 level, 6-in. high-grade vein opened for 200 ft.; face still in good ore.

SCOTTISH-ONTARIO (Porcupine — Control taken by Montreal syndicate. Underground work is to be started shortly. Property was one of the first discoveries of Porcupine, and has been closed several years.

PYRITES PROPERTIES, near Mokomon, about 31 miles west of Fort William, being systematically drilled by Nichols Chemical Co., branch of General Chemical Co., of 25 Broad St., New York; optioned from the estate of the late John Morton and from Alexander Cameron of Fort William.

MEXICO

BOLEO (Santa Rosalia, Baja Calif.)—April copper production was 1,653,680 lb. Ore averaged 3.34%.

REAL DEL MONTE (Pachuca, Hidalgo)—Press reports that mines had been closed by strike are doubted by company officials in United States.

AUSTRALIA

MAMMOTH MOLYBDENITE MINING CO. (Sydney, N.S.W.)—This company has lately acquired 320,000 acres on Mount Tennyson and expects to exploit low-grade molybdenite deposit on large scale. Disseminated surface deposit stated to be 25 ft. thick. Expects to erect flotation plant.

The Market Report

Metal Markets

SILVER AND STERLING EXCHANGE

May	Sterling Exchange	Silver New York, Cents	Silver London, Pence	May	Sterling, Exchange	Silver New York, Cents	Silver London, Pence
17	4.7556	74⅞	38	21	4.7556	74⅞	38
18	4.7556	74⅞	37⅞	22	4.7556	74⅞	37⅞
19	4.7556	74⅞	37⅞	23	4.7556	74⅞	37⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

May	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	28½		10	10	9.10
17	@29	65¼	@10½	@10½	@9.20
	28½		10	10	9¼
18	@29	65	@10¾	@10¾	@9¼
	28½		10	10	9¼
19	@29	65	@11	@11	@9¼
	28½		10	10	9.20
21	@29	65	@11	@11	@9.30
	28½		10	10	9.25
22	@29	65½	@10¾	@10¾	@9.35
	28½		10	10	9.25
23	@29	65¾	@10¾	@10¾	@9.35

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes; ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

May	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
17	130	129½	142	252½	251¾	30½	54
18	130	129½	142	250½	249½	30½	54
19	....	....	....	....	....	....	....
21	130	129½	142	251½	250½	30½	54
22	130	129½	142	254½	253½	30½	54
23	130	129½	142	255¾	253¾	30½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

NEW YORK—May 23, 1917

Most of the principal markets were strong and active this week, with a tendency toward further stiffening of prices.

Wednesday of next week—May 30—being a holiday, we shall go to press on Tuesday afternoon, May 29, and our report of the market for the week will close on that day, and will comprise five days of business following May 23.

Copper, Tin, Lead and Zinc

Copper—Good business was done from day to day, representing chiefly buying by brass makers. Wire drawers figured to some extent; sheet rollers much less so. There was again at least one important transaction for export. We estimate the aggregate of the business of the week at upward of 30 million pounds, which was considerably in excess of the business of the previous week. Nearly all the buying this week was for third-quarter delivery, which is now the major market. Most of the principal producers and agencies made sales. Some were willing to sell only August or August-September, but although July coppper is now scarce, some sellers were willing to book business freely for the entire third-quarter delivery, July included. This business was done at 29c., r.t., although for July alone 30@30½c., r.t., was asked and was obtained. In the early part of the week, August business was taken at 28¾c., r.t., and August-September at 28⅝c., but in the latter part of the week 28⅞c., r.t., for August-September, was obtained on large transactions. The aggregate of business on May 21 was large. Less was done on May 22, but on May 23 there were again some good sales.

Spot and June copper is very scarce, none being offered for resale. A trifling business—a few hundred thousand pounds—for such deliveries was done at 31½@32c., r.t.

Copper Sheets—The price of copper sheets remains the same as shown by our quotation last week. We quote hot rolled at 40@42c, per lb., cold rolled 1c. higher. Wire is now quoted 36@38c., f.o.b. mill.

Tin—The market was rather small. An interesting feature was the arrival of two steamers, bringing approximately 1800 tons of Banka tin. This made that grade of tin in liberal supply and at one time this week it was offered at a discount of as much as 3c. per lb. from the price of Straits tin.

Lead—The tension in this metal becomes more and more acute. Some large producers are so tied up with contracts that they have no metal to offer. Buyers insisting upon obtaining supplies appear willing to pay other producers about what they choose to ask. Small lots of spot lead were reported sold at 11c., New York, with reports of carload lots at higher figures. Round lots—250 tons—were sold at 10½c., May and June deliveries. There was considerable irregularity among prices reported by several producers, and in all cases prices varied materially according to delivery. An interesting feature of the week was some considerable sales for July, August and September. Toward the close, a slightly easier tendency was noted, near-by lead which had previously fetched 11c., St. Louis, being on May 22 reported unsalable at that price with doubts expressed whether 10¾ could be realized. The opinion was expressed in certain quarters that the strangulation of consumption is beginning to show itself. Toward the close of the week, the quotation of the market according to deliveries was about as follows: Spot and May, 10¾@10⅞c.; June, 10½@10¾c.; July, 10⅜@10½c.; August, 10⅛@10⅜c.; September, 9⅞@10⅛c. No particular discrimination between New York and St. Louis was made. The A. S. & R. Co. on May 17 advanced its price to 10c.

Zinc—Transactions were considerably more in volume than in the previous week, and there were some signs of speculative buying. The market became a little stronger, although near-by spelter was pressed for sale right along. Forward delivery was stronger than near-by, sellers of the latter being willing to shade prices a little in order to obtain money quickly. The governing factor in the zinc market at present is that there is an accumulation of unsold stocks.

Zinc Sheets—Price of zinc sheets has not been changed. Market is still at $19 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—The aluminum market continues quiet and devoid of any features of special interest. Quotations continue at about the same level, 59@61c. per lb. for No. 1 ingots at New York.

Antimony—The market is a little easier, and we quote spot at 25@26c. We quote June-July shipment from China at 15½@16½c., c.i.f., New York, duty unpaid.

Nickel—The market remains steady at 50@55c. per lb. for nickel. Electrolytic commands an additional 5c. per lb.

Quicksilver—Price at New York was $105 up to May 22, when it was reduced to $102.50, and on May 23, to $100. Under date of May 22 San Francisco reports, by telegraph, $102, dull.—bought at a discount.

Gold, Silver and Platinum

Gold—According to the report of Samuel Montagu & Co., London, under date of May 3, 1917, the Bank of England gold reserve against its note issue shows a reduction of £220,570, as compared with last week's return. Gold for export, mainly to Japan from New York, only reached about $1,500,000.

Silver—The market for silver for the past week has been very quiet but steady, prices having fluctuated only ⅛ pence.

Direct shipments to London have been limited, while demand for the East still continues. Otherwise there are no special features in the situation.

A report from Samuel Montagu & Co., London, under date of May 3, 1917, notes that the silver market remains narrow and sensitive, and, as has been the case recently, very little buying or selling has an effect on the market totally disproportionate to the amount changing hands. For instance on Apr. 27 quite a moderate amount of buying caused a rise of 5/16d., and a few further orders on Apr. 30 were responsible for a similar movement of 3/8d., and today of 1/4d.

Mexican dollars at New York, May 16, 58c.; 17, 58c.; 18, 57⅞c.; 19, 57⅞c.; 21, 58⅜c.; 22, 58⅛c.

Platinum—Good demand continued. The price was unchanged at $105.

Palladium—There is still much activity in this metal, the price for which remains firm at $105.

Zinc and Lead Ore Markets

Platteville, Wis., May 19—Blende, basis 60% Zn, $77.50 for premium ore down to $70 for medium grade. Lead ore, basis 80% Pb, $128 per ton. Shipments reported for the week are 2472 tons of zinc ore, 99 tons of lead ore, and 673 tons of sulphur ore. For the year to date the figures are: 51,433 tons of zinc ore, 2077 tons of lead ore, and 10,478 tons of sulphur ore. Shipped during the week to separating plants, 3489 tons of zinc ore.

Joplin, Mo., May 19—Blende per ton, high, $82.30; basis 60% Zn, premium ore, $80, medium to low, $77@70; calamine per ton, basis 40% Zn, $40@45; average selling price, all grades of zinc, $73.67 per ton.

Lead, high, $123.20; basis 80% Pb, $115@110; average selling price, all grades of lead, $120.14 per ton.

Shipments—Blende, 10,097 tons; calamine 1301 tons, lead, 2004 tons. Value, all ores the week, $1,080,510. Increase over last year, blende, 29,014 tons; calamine 4366 tons; lead, 6863 tons.

The Southwest Mine Safety and Sanitation Association elected a metal board this week whose duty it will be to collect and collaborate statistics of the cost of ore production, reporting a new formula each month. It has been shown that many reports sent in to the association took no cognisance of the cost of development, depreciation, insurance and interest on investment, and that aside from being a fair estimate of the actual cost of current operating expenses the data heretofore collaborated fails to cover the full cost expense. Few producers maintain a cost sheet account and they do not know when they are running below the price received until their bank account begins to shrink.

Other Ores

Antimony Ore—Sales reported at $2.30 per unit per short ton. It is said that more business could be done at that price if freight from South America could be obtained.

Iron Ore—Prices are nominally as follows; delivered lower Lake ports: Old range bessemer, $5.95; Mesaba, bessemer, $5.70; old range nonbessemer, $5.20; Mesaba nonbessemer, $5.05.

Manganese Ore—This is in strong demand. Any ore, from 36% upward, can be sold if it be of desirable composition. High grade ore, 49%, is quoted at $1 per unit.

Molybdenum Ore—The prices are unchanged. Very little ore is offered.

Pyrites—Spanish ore, furnace size, advanced to 15½c. per unit on basis of 10s. freight, buyer paying war risk and excess freight. Domestic fines mainly under contract at 10@10½c.; spot pyrites scarce, commanding up to 20c. Arranged at recent meeting in New York to secure for fertilizer manufacturers brimstone at special concession.

Tungsten Ore—A fair business was done, but much less than in the previous week. We quote the price unchanged at $20 per unit, basis 60%, for high grade ore. Inferior grades can be

Iron Trade Review

NEW YORK—May 23

With deliveries and mill conditions growing worse, says "Iron Age," capacity sold up to an extent precluding normal interest in new business, and with little certainty as to Government needs except that they will steadily increase, the steel trade moves on in an unsatisfactory way.

The letting of contracts by the Shipping Board for a number of steel vessels has been followed promptly by inquiries for plates and shapes, and it is evidently the plan to have such steel provided directly by the Government. Thus far the Steel Corporation has taken the brunt of the Government's plate demands, and independent plate mills have been little interfered with in supplying their regular trade. This condition, from present indications, will not last long, and plate producers who buy their raw materials view with concern the rising prices of pig iron and scrap. The Government's 2.90c. price on plates is below cost for some mills, though the pig iron now going into their steel was bought $10 to $15 a ton below to-day's market.

Progress is being made on the plans for united buying of steel and other metals by the Government and the Allies. In negotiating for 24,000 tons of wire rope, a portion of which goes to France, the Government has had the coöperation of wire mills, so that wire will be furnished the rope manufacturers as needed. As to prices on all further purchases of steel products, the Government policy is not definitely developed.

PITTSBURGH—May 22

The Government's requirements in steel sheets are being formulated and promise to aggregate a large tonnage, sufficient to require very material postponements in sheet deliveries to other consumers. Price propositions on the Government sheets are now being worked out. Estimates vary as to the present capacity for rolling ship plates, from 120,000 to 175,000 tons a month, the Shipping Board's estimated requirements for small steel merchant vessels, having been set unofficially at 40,000 tons a month. Much new plate capacity, however, is to be completed by about the end of the year.

There is nothing definite as to the tonnage of steel to be bought for the European Allies, but the tonnage is likely to be heavy. The Council of National Defense is working on arrangements to furnish Russia about 13,000 freight cars and France about 10,000 to be built quickly and if possible without setting back deliveries on present car contracts.

While finished steel products are still harder to buy the price advancing tendency is much less marked and it is quite possible that there will be no more general advances. Since Feb. 1 finished steel products have advanced an average of about $20 a ton or 1c. per lb. and of course such a pace could not continue. The Steel Corporation halted its advances last month and it is now below the independents on all products, but it is selling only to its regular trade and then in but a limited way.

Throughout the iron and steel industry production is at a high rate, probably passing the record of last October. The supply of labor is scant but not enough so to restrict production, the effect being felt chiefly in the slowness of new construction work. Car supplies are maintained with difficulty, but are practically adequate.

Pig Iron—With the current supply of scrap limited by reason of the lightness of new construction work, and the constant increase in steel making capacity, indications are that the scarcity of the future will be in pig iron rather than in steel making capacity, and further advances in pig iron are expected. Basic has been quiet. Bessemer sold yesterday in a thousand ton lot at $45, valley, making an advance of $1 a ton. The first important inquiry for bessemer and basic for next year has just appeared, although foundry iron for next year has been moving for some time. We quote: Bessemer, $45@46; basic, $42; foundry and malleable, $43, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Ferroalloys

Ferromanganese—Demand and supply are both light so that the spot market is not well defined but indications point to still greater scarcity. We quote domestic at $425@450 for prompt, $400 for second half and $375 for last quarter, imported being nominal.

Speigeleisen—This material quoted $75@80 for spot and $70@75 for contract.

Ferrosilicon—The 50% material is quoted at $225. Bessemer ferrosilicon, 12%, is quoted at $65.

Coke

Connellsville—With somewhat poorer car supplies furnace coke is scarcer and the spot market is up 25@50c. at $8.25@8.50, foundry being $9.50@10. There are practically no negotiations on contract, buyers and sellers preferring to wait and expecting to do business in the prompt market rather than on contract.

STOCK QUOTATIONS

N. Y. EXCH.†	May 22
Alaska Gold M.	6¼
Alaska Juneau	5
Am.Sm.&Ref.,com.	102¾
Am. Sm. & Ref., pf.	112¾
Am. Sm. Sec., pf. A	97¼
Am. Sm. Sec., pf. B.	90¾
Am. Zinc	33¼
Am. Zinc, pf.	65
Anaconda	82¼
Batopilas Min.	1
Bethlehem Steel	138
Bethlehem Steel, pf.	‡120
Butte & Superior	45¼
Cerro de Pasco	37¾
Chile Cop.	22¼
Chino	57¼
Colo.Fuel & Iron	53½
Crucible Steel	71
Dome Mines	11¼
Federal M. & S.	13
Federal M. & S., pf.	35½
Great Nor., ore ctf.	34½
Greene Cananea	43½
Gulf States Steel	124
Homestake	107
Inspiration Con.	60¼
International Nickel	41
Kennecott	47
Lackawanna Steel	95½
Miami Copper	40¾
Nat'l Lead, com.	56¾
National Lead, pf.	105
Nev. Consol.	25
Ontario Min.	6
Quicksilver	1
Quicksilver, pf.	1¼
Ray Con.	30¼
Republic I.&S. com.	86½
Republic I. & S. pf.	103½
Sloss-Sheffield	54¼
Tennessee C. & C.	17
U. S. Steel, com.	127½
U. S. Steel, pf.	118¼
Utah Copper	114¼
Va. Iron C. & C.	70

N. Y. CURB†	May 22
Big Ledge	3¼
Butte & N. Y.	1¼
Butte C. & Z.	10¼
Caledonia	.55
Calumet & Jerome	1¼
Can. Cop. Corpn.	2
Carlisle	5
Con. Aris. Sm.	2 7/8
Con. Coppermines	5¼
Con. Nev.-Utah	7/8
Emma Con.	1 7/8
First Nat. Cop.	3
Goldfield Con.	.49
Goldfield Merger	.04½
Greenmonster	1 7/8
Hecla Min.	8
Howe Sound	6½
Jerome Verde	1¼
Joplin Ore & Spel.	.16
Kerr Lake	4 3/4
Magma	48½
Majestic	45
McKinley-Dar-Sa.	.51
Mohican	.75
Mother Lode	.27
N. Y. & Hond.	14
Nipissing Mines	7¼
Ohio Cop.	1 1/8
Ray Hercules	3¼
Rochester Mines	.67
St. Joseph Lead	18¼
Seneca	1¼
Standard S. L.	1 1/8
Stewart	.25
Success	.37
Tonopah	5¼
Tonopah Ex.	2¼
Tribullion	.25
Troy Arizona	1/8
United Cop.	.30
United Verde Ext.	38
United Zinc	4¼
White Knob, pf.	11
White Oaks	‡2
Yukon Gold	2¼

SAN FRAN.*	May 22
Alta	.04
Andes	.12
Best & Belcher	.05
Bullion	.02
Caledonia	.12
Challenge Con.	.01
Confidence	.10
Con. Virginia	.52
Gould & Curry	.03
Hale & Norcross	.05
Jacket-Cr. Pt.	.05
Mexican	.25
Occidental	.55
Ophir	.07
Overman	.03
Savage	‡.04
Seg Belcher	.02
Sierra Nevada	.09
Union Con.	.32
Utah Con.	.02
Belmont	3.90
Jim Butler	.75
MacNamara	.14
Midway	.13
Mont.-Tonopah	‡.19
North Star	.09
Rescue Eula	.23
West End Con.	.64
Atlanta	.09
Booth	.07
Comb. Frac.	.04
D'field Daisy	.03
Florence	.17
Jumbo Extension	.36
Kewanna	.12
Nevada Packard	.36
Round Mountain	.34
Silver Pick	.09
White Caps	1.32½
Big Jim	.70
Lazy Boy	‡.05
Nellie	‡.15½
Tom Reed	‡1.93½
United Eastern	4.00

BOSTON EXCH.*	May 22
Adventure	3
Ahmeek	100
Algomah	.70
Alloues	65½
Ariz. Com., ctfs.	14
Arnold	.30
Bonanza	.20
Butte-Balaklava	.80
Calumet & Aris.	81½
Calumet & Hecla	544
Centennial	18½
Copper Range	65
Daly West	1½
Davis-Daly	5
East Butte	12½
Franklin	6¼
Granby	82
Hancock	16
Hedley	16
Helvetia	.35
Indiana	2½
Island Cr'k, com.	68
Isle Royale	30½
Keweenaw	2¼
Lake	13
La Salle	3¼
Mason Valley	5¾
Mass	12½
Mayflower	2¼
Michigan	3¼
Mohawk	89
New Arcadian	3½
New Idria	15
North Butte	22
North Lake	1¼
Ojibway	1¼
Old Colony	2¼
Old Dominion	62
Osceola	87¼
Quincy	88
St. Mary's M. L.	81
Santa Fe	1¾
Shannon	8¼
Shattuck-Ariz.	26
So. Lake	3¼
So. Utah	.17
Superior	9¼
Superior & Bost.	5¼
Trinity	3¼
Tuolumne	.90
U. S. Smelting	.58
U. S. Smelt'g, pf.	50
Utah Apex	2¼
Utah Con.	16¼
Utah Metal	5
Victoria	4
Winona	3¼
Wolverine	42½
Wyandot	.90

BOSTON CURB*	May 22
Alaska Mines Corp.	1
Bingham Mines	11¼
Boston Ely	.45
Boston & Mont.	.65
Butte & Lon'n Dev.	.22
Calaveras	3¼
Calumet-Corbin	.01¼
Chief Con.	2¼
Cortez	.15
Crown Reserve	.30
Crystal Cop	.90
Eagle & Blue Bell	.2
Houghton Copper	.90
Intermountain	1 7/8
Iron Cap Cop., pf.	17¼
Mexican Metals	.25
Mines of America	1¼
Mojave Tungsten	.43
Nat. Zinc & Lead	.40
Nevada-Douglas	1¼
New Baltic	1¼
New Cornelia	16¼
Oneco	.50
Pacific Mines	‡.25
Rex Cons.	.28

SALT LAKE*	May 22
Bannack	1.15
Big Four	.62
Black Jack	.06
Cardiff	5.50
Colorado Mining	.17
Crown Point	‡.05
Daly-Judge	7.50
Empire Copper	1.25
Gold Chain	.11
Grand Central	.47
Iron Blossom	1.00
Lower Mammoth	.03
May Day	.06¼
Moscow	.12
Prince Con.	1.25
Silver-King Coal'n.	2.97½
Silver King Con.	3.00
Sioux Con.	.11¼
So. Hecla	1.10
Uncle Sam	.03
Wilbert	.10
Yankee	.11½

TORONTO*	May 22
Bailey	.03
Beaver Con.	.32
Buffalo Mines	.95
Chambers Ferland	.10
Conlagas	3.50
La Rose	.44
Peterson Lake	.09
Right of Way	.04
T. & Hudson Bay	38.00
Temiskaming	.37
Wettlaufer-Lor.	.05
Dome Exten.	.12½
Dome Lake	.17
Foley O'Brien	.70
Hollinger	4.30
Jupiter	.28
McIntyre	1.37
Newray	.72
Porcu. Crown	.55
Schumacher	.41
Vipond	.37
West Dome	.18½

STOCK QUOTATIONS—Continued

COLO. SPRINGS	May 22
Cresson Con.	5.75
Doctor Jack Pot	.05
Elkton Con.	.06½
El Paso	.29
Gold Sovereign	.03¾
Golden Cycle	2.25
Granite	.54
Isabella	.11
Mary McKinney	.22
Portland	1.45
United Gold M.	.16
Vindicator	.70

LONDON	May 4		
Alaska Mexican	£0	10s	0d
Alaska Tre'dwell	1	15	0
Burma Corp.	4	1	3
Cam & Motor	0	8	6
Camp Bird	0	7	3
El Oro	0	9	0
Esperanza	0	10	9
Mexico Mines	4	0	0
Nechi, pfd.	0	14	0
Oroville	0	15	6
Santa Ger t'dis	0	10	6
Tomboy	0	19	6

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1915	1916	1917	1915	1916	1917
January	48.855	56.775	75.630	22.731	26.960	36.682
February	48.477	56.755	77.585	22.753	26.975	37.742
March	50.241	57.935	73.861	23.708	27.597	36.410
April	50.250	64.415	73.875	23.709	30.662	36.963
May	49.915	74.269		23.570	35.477	
June	49.034	65.024		23.267	31.060	
July	47.519	62.940		22.597	30.000	
August	47.163	66.083		22.780	31.498	
September	48.680	68.515		23.591	32.584	
October	49.385	67.855		23.925	32.361	
November	51.714	71.604		25.094	34.192	
December	54.971	75.765		26.373	36.410	
Year	49.684	65.661		23.675	31.315	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1916	1917	1916	1917	1916	1917
Jan.	24.008	28.673	88.083	131.921	116.167	142.895
Feb.	26.440	31.750	102.667	137.895	133.167	148.100
Mar.	26.310	31.481	107.714	136.750	136.000	151.000
April	27.895	27.935	124.319	133.842	137.389	147.158
May	28.625		135.457		152.522	
June	26.601		112.432		137.455	
July	23.865		95.119		125.500	
Aug.	26.120		110.283		126.304	
Sept.	26.855		113.905		134.071	
Oct.	27.193		122.750		142.523	
Nov.	30.625		134.659		155.432	
Dec.	31.890		145.316		162.842	
Year	27.202		116.059		138.281	

Tin	New York		London	
	1916	1917	1916	1917
January	41.825	44.175	175.548	185.813
February	42.717	51.420	181.107	198.974
March	50.741	54.388	193.609	207.443
March	51.230	55.910	199.736	220.171
May	49.125		196.511	
June	42.231		179.466	
July	38.510		168.357	
August	38.565		169.870	
September	38.830		171.345	
October	41.241		179.307	
November	44.109		186.932	
December	42.635		183.368	
Av. year	43.480		182.096	

Lead	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
January	5.921	7.626	5.826	7.530	31.167	30.500
February	6.246	8.636	6.164	8.595	31.988	30.500
March	7.136	9.199	7.375	9.120	34.440	30.500
April	7.630	9.288	7.655	9.158	34.368	30.500
May	7.463		7.332		32.967	
June	6.936		6.749		31.011	
July	6.352		6.185		28.137	
August	6.244		6.088		29.734	
September	6.810		6.699		30.786	
October	7.000		6.898		30.716	
November	7.042		6.945		30.500	
December	7.513		7.405		30.500	
Year	6.858		6.777		31.359	

Spelter	New York		St. Louis		London	
	1916	1917	1916	1917	1916	1917
Jan.	16.915	9.619	16.745	9.449	89.810	48.329
Feb.	18.420	10.045	18.260	9.875	97.762	47.000
Mar.	16.846	10.300	16.676	10.130	95.048	47.000
April	16.695	9.459	16.525	9.289	99.056	54.632
May	14.276		14.106		94.217	
June	11.752		11.582		68.591	
July	8.925		8.755		50.750	
Aug.	8.730		8.560		51.587	
Sept.	8.990		8.820		52.095	
Oct.	9.829		9.659		54.159	
Nov.	11.592		11.422		56.023	
Dec.	10.665		10.495		55.842	
Year	12.804		12.634		72.071	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. ¼ Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1916	1917	1916	1917	1916	1917
January	$21.60	$35.95	$18.78	$30.95	$19.70	$30.95
February	21.16	36.37	18.93	30.95	19.51	30.95
March	21.81	37.37	19.20	33.49	19.45	35.91
April	21.65	42.23	18.95	38.90	19.45	40.06
May	21.78		19.11		19.58	
June	21.95		18.95		19.34	
July	21.95		18.95		19.20	
August	21.95		18.95		19.22	
September	22.88		19.58		19.53	
October	24.61		21.26		21.51	
November	30.07		28.18		26.55	
December	35.16		30.95		30.79	
Year	$23.88		$20.98		$21.15	

‡ As reported by W. P. Snyder & Co.